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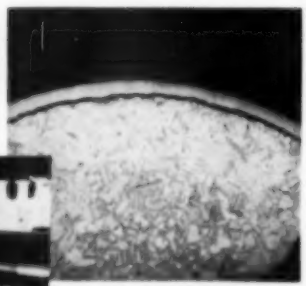

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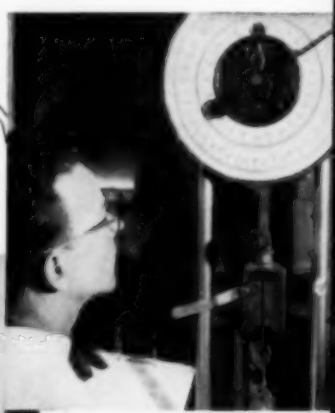

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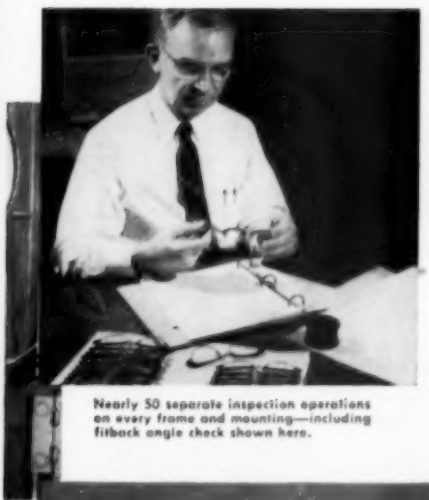

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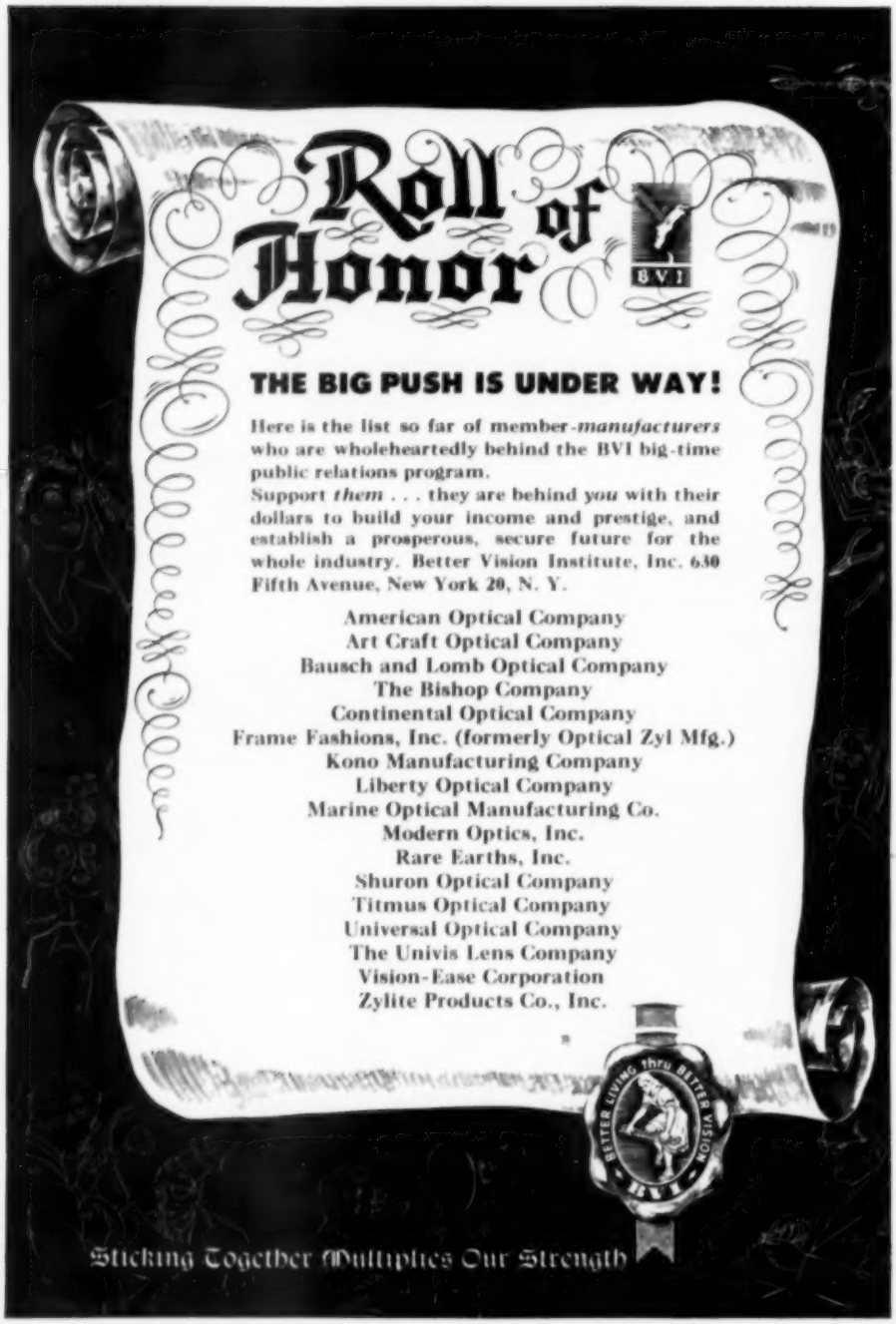
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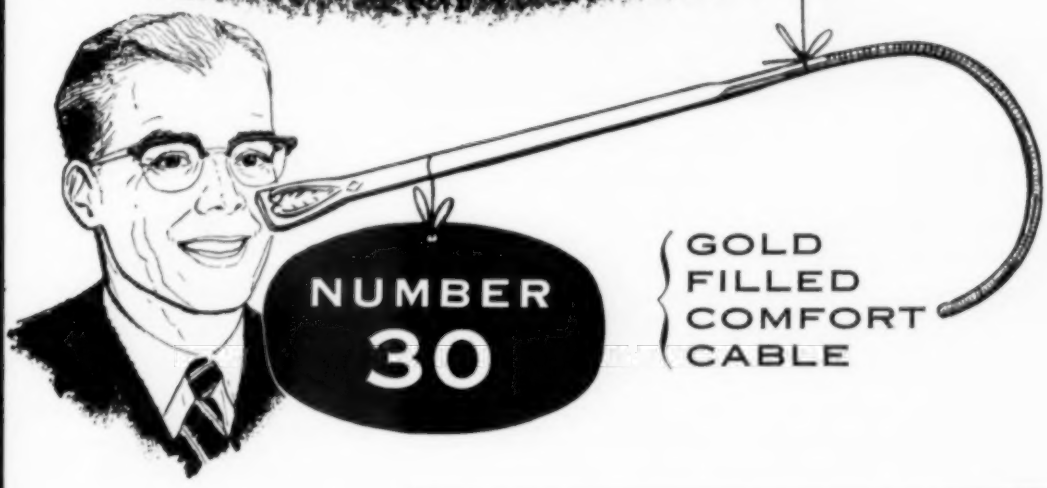

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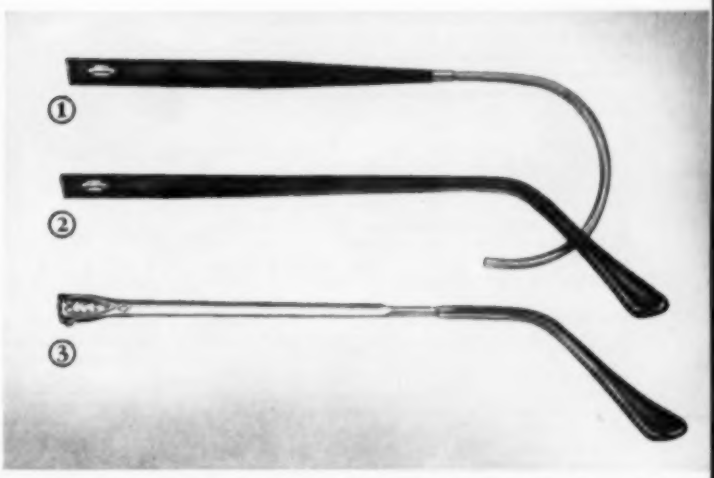

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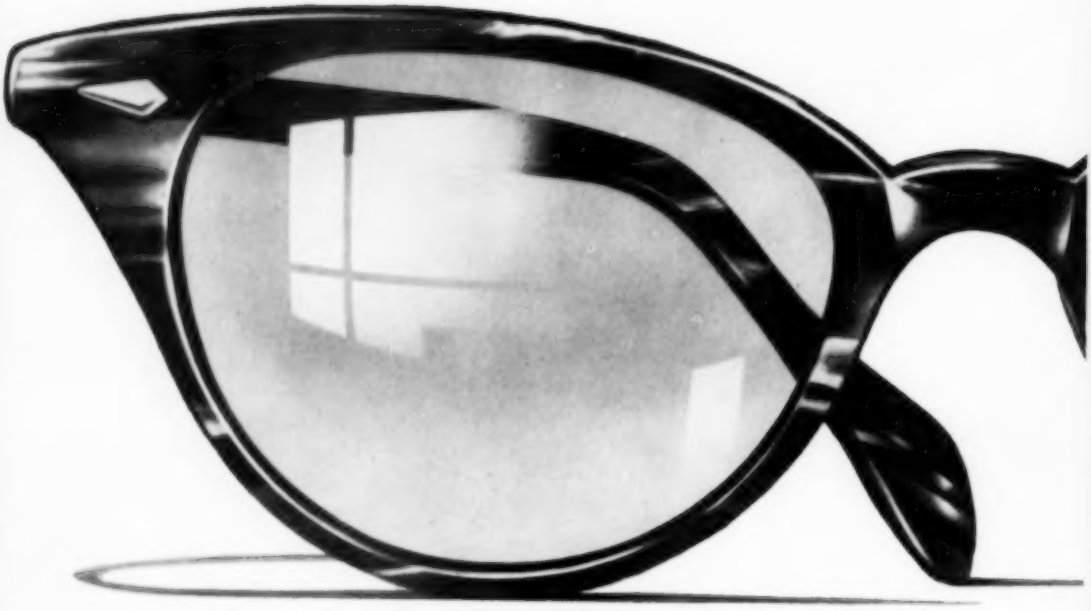

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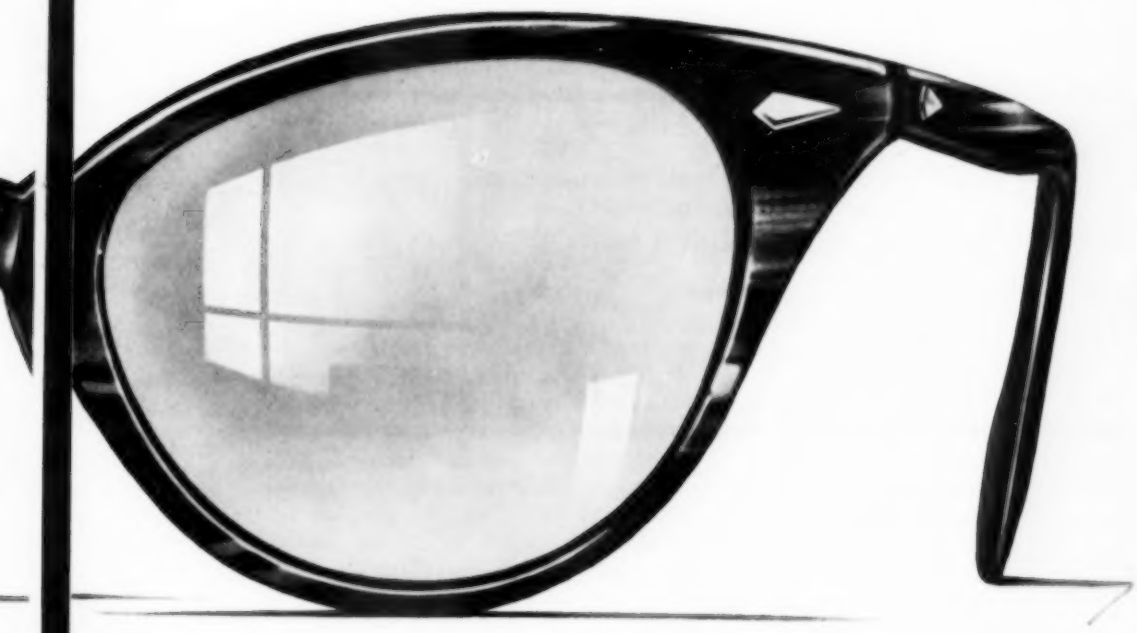

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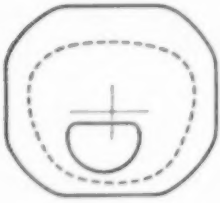

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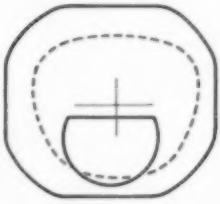

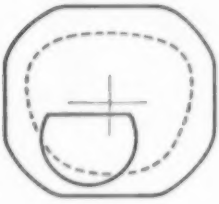

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VARIATIONS IN CONVERGENCE AND ACCOMMODATION INDUCED BY SUCCESSIVE SPHERICAL LENS ADDITIONS WITH DISTANCE FIXATION — AN INVESTIGATION*

WITH THE DESCRIPTION OF A CLINICAL METHOD FOR TESTING THE VALIDITY OF THE REFRACTIVE CORRECTION

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School of Optometry, University of California
Berkeley, California

INTRODUCTION

To avoid stimulating accommodation when visual fixation is maintained at distance is a classical philosophy.[1, 2, 3, 4, 5, 6, 7, 8] Thus, most clinicians start the subjective refraction test with a lens that "fogs the eye."** Also, this philosophy probably accounts for the many clinical procedures in use which result in the prescribing of additional plus lens power for distance wear. The common contention is that added plus lenses induce maximum relaxation of accommodation for distance fixation. At least two types of evidence do not support this belief.

The first type of evidence is based on data representing the relationship between visual acuity and the degree of uncorrected myopia. Such data have been published by Laurance and Wood,[9] Hirsch,[10] and Crawford et al.[11]

Laurance and Wood believed that the reduction of visual acuity in uncorrected myopia is the same as occurs in absolute hypermetropia as well as in the artificial myopia produced by fogging lenses. In an investigation on the effects of fogging lenses on accommodation, Reese and Fry[12] compared the acuity data from one of their subjects (Fry), whose accommodation had been paralyzed by atropine, with the data presented by Laurance and Wood.[9] With the addition of fogging lenses, the visual acuity for the atropinized eye was found to be better than the

*Read before the annual meeting of the American Academy of Optometry, Chicago, Illinois, December 8, 1953. For publication in the March, 1955, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

The author wishes to thank Professor Meredith W. Morgan, Jr., School of Optometry, University of California, for originally suggesting this investigation.

†Optometrist. M.Opt. Member of faculty. Fellow, American Academy of Optometry. Research Fellow, American Optometric Foundation.

**This expression is commonly used to refer to the artificial myopia created by added convex spherical lenses which image the test target anterior to the foveal cones.

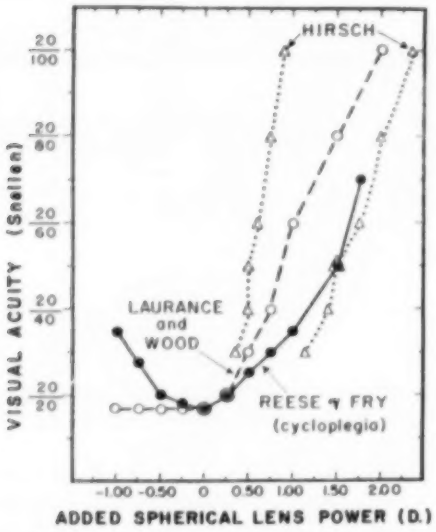

Fig. 1. Solid curve (Reese and Fry): visual acuity versus added spherical lens power for an adult subject under atropine cycloplegia. Dashed curve (Laurance and Wood): visual acuity versus added spherical lens power or the degree of uncorrected myopia, with accommodation dynamic. Dotted curves (Hirsch): the ninety-five per cent confidence limits for the expected degree of uncorrected myopia for various visual acuities obtained from sixty-four young college adults without cycloplegia.

average acuity for the unatropinized eyes (Figure 1).* According to Reese and Fry (p. 10), "This indicates that the subjects used by Laurance permitted more and more accommodation to come into play as the power of the fogging lens was increased."

The second kind of evidence is as follows. Using a Badal optometer and a three millimeter artificial pupil, Reese and Fry[12] measured the accommodative response for twelve unatropinized subjects as various spherical lenses were added to the refractive correction. They concluded (p. 16), "The results show that an eye may react to an increase in fog either by forcing a greater degree of relaxation or by permitting more accommodation to come into play, but as a general rule it remains passive."

The main purpose of the investigation to be described was to test the contention that fogging lenses induce maximum inhibition of accom-

*It is interesting to note that Fry's curve lies within the ninety-five per cent confidence limits as found by Hirsch[10] on young college adults with uncorrected myopia and not under the influence of a cycloplegia (Fig. 1). A comparison of Fry's visual acuity with and without cycloplegia would have been of greater value.

modation when fixation is at distance. This was to be done by attempting to confirm the conclusion of Reese and Fry. If fogging lenses can induce accommodation to react in three different ways, then accommodative convergence should be expected to vary in three corresponding ways since it is known that accommodative convergence will change whenever accommodation changes.[13, 14, 15, 16, 17, 18] The method to be used was to observe the systematic changes in controlled clinical measurements of the lateral heterophoria at six meters as various fogging lenses were added. An additional purpose of the investigation was to look for possible clinical applications of the method by studying the nature of the measured changes in convergence and the calculated changes in accommodation brought about by adding plus and minus spherical lenses to the refractive correction.

RATIONALE

Convergence can be analyzed according to its components: tonic convergence, fusional convergence, psychic convergence and accommodative convergence.[14, 18, 19] When care is taken in measuring the lateral heterophoria at six meters by the Maddox rod technique, these components usually will remain essentially constant. If tonic convergence does vary somewhat during the measuring period it generally is a random variation, or at least a variation which is not synchronous with changes in accommodation. To minimize impulses to fusional convergence, a special procedure can be employed (see Instrumentation and Procedure). According to Harrigan[20] the magnification and minification effects of plus and minus added lenses do not influence psychic convergence greatly when the test target is as distant as four meters. The only component of convergence likely to vary systematically with successive spherical lens additions is accommodative convergence. Therefore, it can be assumed that systematic variations in the lateral heterophoria measurements represent changes in accommodative convergence brought about by the influence of the added spherical lenses on accommodation.

The ratio of accommodative convergence to accommodation (the A.C.A. ratio) expresses the amount of accommodative convergence that is associated with each diopter of accommodation. If this ratio for a subject is known, the changes in accommodative convergence can be used to determine the amount that accommodation has changed. This is done by dividing the change in accommodative convergence by the A.C.A. ratio.

INSTRUMENTATION AND PROCEDURE

The measurements for this investigation were made in a refracting room in the School of Optometry Building at the University of Cali-

fornia. There were thirty-four subjects: thirty had normal binocular vision and normal visual acuity.* For nine of the subjects (eight, male, fourth-year optometry students and a female optometrist) the equipment consisted of an American Optical Company phoropter, model number 589, a Projecto-Chart with a twenty-foot throw via a double mirror system, a point source of light, and a multiple Maddox rod placed in the auxiliary lens clip in front of the aperture of the phoropter. The point source of light was mounted on the wall above and behind the phoropter, and was visible by reflection from the second mirror in the projection system. For the remaining twenty-five subjects (twenty-four, male, third-year optometry students, and a male university engineering student) the same room and equipment were used except that a Clason Acuity Meter was used in place of the Projecto-Chart. The purpose of this change was to provide a greater variety of fixation letters in order to minimize memorization and thereby probably improve the accuracy of fixation and accommodation. Furthermore, the use of this instrument made it possible to alter the size of the letters to minimum readability by a simple adjustment of the sliding arm.

For the first nine subjects, the refractive data supplied at the initial trial by each of the subjects were used for all subsequent measurements. A subjective refraction was performed by the investigator for the remaining twenty-five subjects. This refraction was done for one eye at a time while the other eye was occluded. Except in one respect, the technique employed was not different from that used by most optometrists. This difference consisted of not "pushing plus," i.e., when two lenses 0.25 D. different in power were presented to the subject for comparison, the investigator did not hesitate to give the stronger minus lens or the weaker plus lens if the subject reported that the letters (minimum readable) appeared "clearer" or "better." The subject did not have to demonstrate that he could read more letters through one lens or another, but simply had to express a preference based on the clarity of the letters. Occasionally, when a subject claimed no preference between two lenses 0.25 D. different in power, the lens of more minus power or less plus power was arbitrarily given.

With the interpupillary distance set and the refractive correction placed in the phoropter, a red filter, a multiple Maddox rod with its axis oriented horizontally, and a 15△ Risley prism were centered before

*Approximately one-third of these subjects had a subjective refraction of more than —0.75 D.S. or —0.75 D.C.; one subject had a high convex lens correction; the remaining subjects had small or negligible corrections. Such a distribution of refractive corrections among optometry students is neither surprising nor unexpected. It is not believed that this selection of subjects materially affected the character of the results (see discussion of Relationship to Heterophoria).

the left eye of the subject who was seated comfortably behind the phoropter. A white 4" x 6" card was then used to occlude the left eye. A vertical row of "just-readable" Snellen letters, visible only to the subject's right eye, was projected so that its center was seen to be in vertical alignment with the point source of light.

The subject was then instructed to read the letters aloud from top to bottom repeatedly and to keep them as clear as possible at all times. At an appropriate and unannounced time the investigator momentarily uncovered the left eye so that the subject saw a brief exposure of a vertical streak of red light. The subject was required to make a judgment as to whether the streak appeared to the left or to the right of the center of the letter being fixated at the moment of uncovering. It was emphasized to each subject that he should not report the line as being in the center of the letters since the only acceptable answers were "left," "right," or "doubtful." Random changes in the power of the Risley prism, to the nearest 0.5△, were made and the subject's answer for each prism setting was noted. Generally, after about ten separate judgments, two prism values were obtained which represented the upper and lower limits for judgments of 100 per cent certainty. The interval between these limits was called the "interval of uncertainty," i.e., the interval containing the doubtful judgments as well as the mixed judgments of right and left.* The prism value corresponding to the midpoint of the "interval of uncertainty" was recorded as the distance lateral heterophoria measurement.

Similar data were obtained for various spherical lens additions by repeating the testing procedure with the subject viewing the letters and the vertical streak through each of the following added lenses in random order: +0.50 D., +1.00 D., +1.50 D., +2.00 D., —0.50 D., —1.00 D., —1.50 D., and —2.00 D. Both eyes were occluded while the lenses were being changed. When plus fogging lenses were in place, larger letters were used so that the subject always had some "just-readable" letters in view. For some subjects, when the binocular lens addition was +2.00 D., the horizontal bars of a 20/200 "E" were projected in the vertical rectangle of light. Under these circumstances the instructions were to fixate along an imaginary vertical center-line of the rectangle of light and to keep the contour edges of these bars as clear as possible. At a few of the trials the contour edges of these bars could not be seen by the subject, in which case measurements for that lens addition were not taken. Heterophoria measurements were not recorded

*This method of taking measurements has been referred to by Guilford[21] as the "method of constant stimulus differences." According to Stevens[22] this sort of method is a "special case of paired comparisons."

for minus lens additions which caused a decrease in visual acuity of more than one line as determined *during* the measurement of the lateral heterophoria.

For those subjects having more than a single trial, the subsequent trials were, as a rule, scheduled several days apart, although in a few instances two trials were performed on the same day (J. Ca., W. J., R. S., and S. Z.), and for one subject (S. L.) three trials were run at intervals during a single day.

EXPERIMENTAL RESULTS

The data obtained at each trial were plotted on a graph in which the abscissa denoted the distance lateral heterophoria measurement in prism diopters and the ordinate represented the added spherical lens power in diopters. Curves were drawn by connecting each pair of successive points with a straight line segment. Four characteristic groups of curves were identified.

The distinguishing feature of a Group I curve was the relative constancy of the heterophoria measurements when plus fogging lenses were added. This can be interpreted to mean that accommodation did not change significantly with the addition of plus lenses. Classification into Group I was based on two criteria. (1) With the addition of plus lenses the change in the heterophoria measurement was less than 1△. In a few instances curves were placed in this group even though the 'phoria measurements did change by 1△ or more. This was done because the scatter of the points made it impossible to place the curve into any of the other groups. (2) When the fogging lenses were added, the calculated change in accommodation was less than 0.25 D. The accommodative change was calculated by dividing the change in the heterophoria measurement (in △) by the slope of the curve (in △/1.00 D.) resulting from the addition of minus lenses.* The slope** was evaluated by drawing the "best-fit" straight line determined by using the three point mean method.[23] Examples of Group I curves are shown in Figure 2.

A curve was designated as a Group II curve if, when plus lenses were added, an increase in convergence of 1△ or more occurred, or if accommodation increased by 0.25 D. or more. The curves in this group

*The reasoning here is based on the assumption that the accommodative response is equal to the accommodative stimulus. Haploscopic data indicate that the accommodative response usually lags behind the accommodative stimulus. Although the above assumption is not necessarily correct, it had usefulness in classifying the curves. An analysis of the curves in terms of accommodative response is presented later in the paper.

**By custom the slope of the line representing the relationship between accommodative convergence and accommodation is expressed as the reciprocal of the mathematical slope of the line.

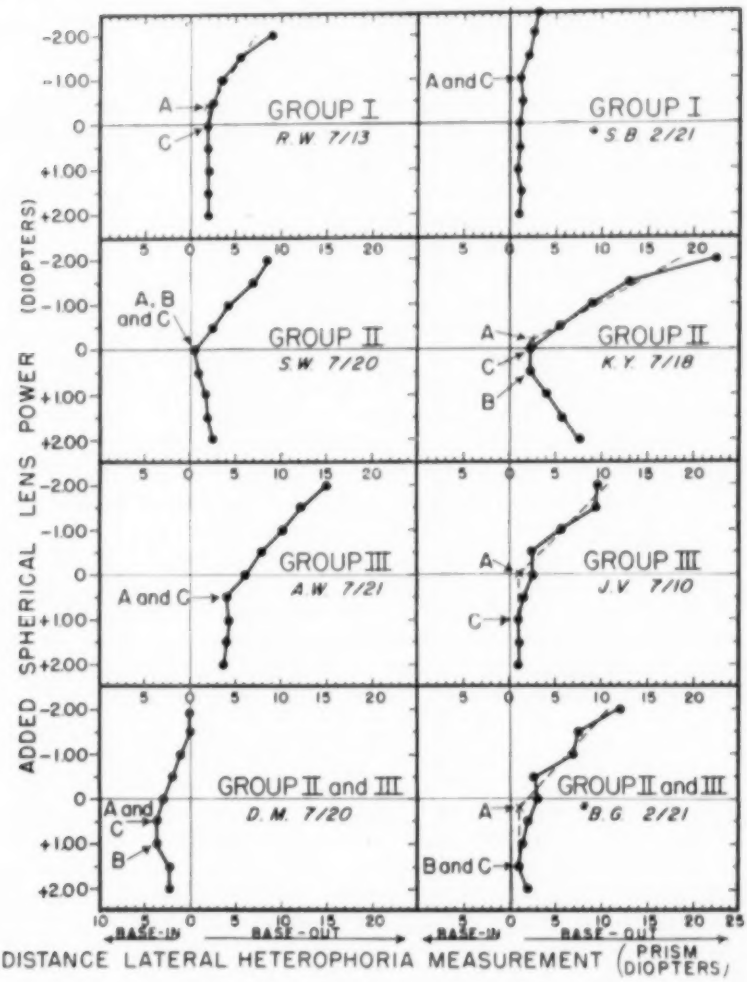

Fig. 2. Sample curves for the four groups identified when distance lateral heterophoria measurements were plotted against added spherical lens power. The asterisk indicates that the subject supplied his own refractive data which were used for subsequent experimental measurements. See text for criteria used in classifying curves and establishing location of Points A, B, and C.

showed what may be called a "knee-back," i.e., an inflection point (Point B) at which the curve bent towards more base-out or less

base-in for added plus lenses. Typical Group II curves are shown in Figure 2.

Some curves showed a decrease in convergence of 1△ or more, or a decrease in accommodation of 0.25 D. or more when plus lenses were added. Such curves were placed in Group III. Representative curves of this group are shown in Figure 2.

The placement of curves into only one of these three groups was not always possible. In several instances it was necessary to classify a curve into a fourth group, Group II,III. Curves in this group showed both Group II and Group III characteristics (see Figure 2).

Certain critical points were labelled on the graphs in order to describe and analyze the curves more fully. Point A is the point of intersection of the "slope-line" with a vertical line drawn through the average minimum convergence. This point is evident on all the curves obtained. Point B is the point at which the "knee-back" occurs and there is present only for curves having Group II characteristics. Point C, a datum point, is the least plus ordinate value at which the minimum convergence ($\pm 0.5\triangle$) is evident. The location of all these points is denoted by their ordinate values only (Figure 2).

Table I shows the experimental results and other data for the subjects at each of their trials. Column 1 lists the subjects alphabetically. An asterisk indicates that the data for the refractive correction were supplied by the subject himself and that these data were used for all subsequent measurements. Column 2 gives the month and day of the trial. All trials were in 1950 except the last two for subject K. Y., which were in 1951. The distance lateral heterophoria measurement with no lens addition is shown in Column 3. Esophoria is denoted by S and exophoria by X. Column 4 indicates the ordinate value of Point A. The measured slope of each curve is shown in Column 5. In Column 6 is listed the A.C.A. ratio as measured on the haploscope* for some of the subjects. The group classification of each curve is indicated in Column 7.

Columns 8 through 11 pertain to those curves having Group II ("knee-back") characteristics. In Column 8 is found the maximum increase in convergence resulting from the application of plus fogging

*The particular instrument used consisted of a Badal optometer for changing the accommodative stimulus, a coincidence optometer (designed in principle after an instrument by Fry[24]) which measured the accommodative response of the eye, and an automatic recording mechanism developed by Dr. Robert F. Harrigan, University of California School of Optometry, and constructed with funds granted by the American Academy of Optometry. The measurements made on this haploscope and used in the present investigation were performed by Dr. Harrigan, to whom the author is indebted.

TABLE I

Experimental results and other data for the subjects at each of their trials. For complete explanation of table see text (Experimental Results).

							GROUP II				GROUP III			
Subj.	Date	Phoria 6 M. Δ	Loc. Pt. A D Δ/1.00D	Meas. Slope Δ/1.00D	Hapl. A.C.A.	Group	Conv. Incr. Δ	Accom. Meas. D	Accom. Hapl. D	Loc. Pt. B D	Conv. Decr. Δ	Accom. Meas. D	Accom. Hapl. D	Loc. Pt. C D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A.B.	7/18	½ S	0.00	3.0		II	1	0.3		+0.50				0.00
	7/19	¼ S	—0.50	4.0		II	1¾	0.4		0.00				—0.50
	7/20	¼ X	0.00	2.3		II	2	0.9		0.00				0.00
P.B.	6/26	5½ S	0.00	5.5		I								+1.00
	7/3	3 S	—0.25	8.5		II	2	0.2		+0.50				+0.50
	7/13	5 S	0.00	7.5		I								+1.00
	7/17	13 S	+0.50	5.8		II.III	1½	0.3		+0.50	—3	—0.5		+0.50
R.B.	6/30	1 S	0.00	10.6	5.0	I								+1.50
	7/3	1 S	—0.37	11.3		I								0.00
	7/10	½ S	—0.50	10.7		I								0.00
	7/17	2 S	—0.50	8.5		I								0.00
*S.B.	2/21	1 S	—1.00	1.3		I								+1.00
*T.B.	2/20	7 X	—0.12	2.1		I								+1.00
*B.C.	3/15	1¾ S	0.00	12.0		I								+1.50
J.Ca.	6/30	¼ X	—1.00	5.0	5.0	I								—0.50
	7/13	1 S	—0.20	5.2		III					—1	—0.2	—0.2	+0.50
	7/20	1 X	0.00	3.2		II	1¼	0.4	0.3	0.00				0.00
	7/20	¼ X	—0.75	7.8		II	1¼	0.2	0.3	0.00				0.00
J.Co.	7/13	9 X	—0.50	4.0	2.7	II	2	0.5	0.7	+1.50				0.00
	7/21	6¼ X	—0.30	6.5		I								0.00
*S.C.	2/14	½ S	+0.50	1.9		II.III	½	0.3		+1.00	—1	—0.5		+0.50
B.F.	6/30	1 X	0.00	3.0	4.9	I								0.00
	7/5	0	—0.50	4.0		I								—0.50
	7/12	½ X	—0.50	3.5		II		0.6	0.4	+1.00				0.00
	7/19	¼ X	—0.50	4.00		I								0.00
*R.F.	2/14	6½ S	+0.62	5.0		III					—3½	—0.7		+1.00
*B.G.	2/21	3 S	+0.12	4.4		II.III	1	0.2		+1.50	—2	—0.5		+1.50
R.J.	7/3	17 X	none	1.0	6.4	III					—4	—4.0	—0.6	+1.50
	7/10	17 X	—1.00	4.0		I								+1.50
	7/17	20 X	—0.25	4.1		III								+0.50

(Continued on Next Page)

TABLE I—(Continued)

Experimental results and other data for the subjects at each of their trials. For complete explanation of table see text (Experimental Results).

							GROUP II				GROUP III			
Subj.	Date	Phoria 6 M. Δ	Loc. Pt. A D	Meas. Slope Δ/1.00D	Hapl. A.C.A. Δ/1.00D	Group	Conv. Incr. Δ	Accom. Meas. D	Accom. Hapl. D	Loc. Pt. B D	Conv. Decr. Δ	Accom. Meas. D	Accom. Hapl. D	Loc. Pt. C D
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
W.J.	7/12	6½ S	—0.25	14.0	7.9	II	2	0.1	0.3	+1.50				+0.50
	7/19	3½ S	0.00	6.3		I								+1.50
	7/19	6 S	0.00	9.3		II	1¼	0.1	0.2	0.00				0.00
F.K.	7/11	6 S	—0.37	8.5		I								+1.00
	7/17	5 S	—0.25	8.8		I								+1.00
J.K.	6/27	4 X	0.00	7.5		I								+1.50
	7/5	5 X	—0.25	9.0		I								0.00
	7/11	4 X	0.00	5.5		II.III	3½	0.6		+1.50	—1	—0.2		+0.50
	7/21	3 X	—0.62	5.5		I								+0.50
A.L.	7/5	2 S	+0.20	3.0	4.6	III					—1	—0.3	—0.2	+0.50
	7/12	4½ S	—0.12	3.5		I								+2.00
	7/19	5 S	+0.12	2.5		III					—1	—0.3	—0.2	+0.50
B.L.	7/6	3 X	—1.00	1.5	4.4	II	1½	1.0	0.3	—0.50				—1.00
	7/18	1 X	—0.50	1.5		II	1½	1.0	0.3	+0.50				+0.50
	7/20	1½ X	—0.50	1.3		II	½	0.4	0.1	+0.50				—0.50
*C.L.	3/31	3 S	+0.50	8.3		II	2	0.2		0.00				0.00
S.L.	7/6	3 X	0.00	2.0	2.9	II	2	1.0	0.7	+1.00				0.00
	7/19	1¾ X	0.00	2.0		II	2	1.0	0.7	+1.50				0.00
	7/19	1¾ X	+0.12	2.4		I								+0.50
	7/19	1¾ X	0.00	2.0		II	2	1.0	0.7	+1.00				+1.00
D.M.	7/5	1 X	—0.25	6.0	5.2	II	1	0.2	0.2	—0.25				0.00
	7/6	3½ X	0.00	4.5		II	2	0.4	0.4	0.00				0.00
	7/13	1 S	—0.25	8.1										0.00
	7/20	3 X	+0.50	1.8		II.III	1½	0.8	0.3	+1.00	— ¾	—0.4	—0.1	+0.50
*R.M.	2/20	1½ S	+0.12	6.5		II	1	0.1		+1.00				+1.00
	3/17	1½ S	+0.10	5.6		II	2¼	0.4		+1.00				+0.50
S.M.	6/29	1½ S	0.00	4.0	5.2	I								0.00
	7/6	3½ S	—0.30	9.0		I								+2.00
	7/13	3½ S	+0.12	4.0		I								+0.50
	7/21	1¾ S	—0.25	4.3		I								0.00

H.P.	7/3	1½ X	0.00	1.8	3.7	I								0.00
	7/10	1½ X	0.00	1.0		II	1½	1.5	0.4	0.00				0.00
	7/17	½ X	0.00	2.00		I								0.00
	7/20	0	—0.50	1.0		II	1½	1.5	0.4	+1.00				0.00
*J.S.	2/21	½ X	—0.62	3.7		I								0.00
R.S.	7/11	1 S	—0.25	1.5	8.7	I								0.00
	7/17	1½ S	—0.50	2.5		I								0.00
	7/17	3½ S	—0.37	1.8		I								0.00
	7/20	1 S	—0.50	1.2		I								+1.50
G.T.	7/11	7 X	0.00	3.8	5.9	II	1½	0.4	0.3	0.00				0.00
	7/18	10 X	0.00	3.3		II	1½	0.5	0.3	+0.50				0.00
	7/19	7½ X	0.00	4.0		I								+2.00
J.V.	6/26	0	—0.25	2.1	6.6	I								0.00
	7/3	0	—0.50	3.3		I								+0.50
	7/10	2½ S	0.00	4.8		III					—1½	—0.3	—0.2	+1.00
	7/17	4½ S	+0.25	3.5		III					—1½	—0.4	—0.2	+1.00
A.W.	6/28	2 S	+0.25	3.0	4.6	II.III	1	0.3	0.2	+1.00	—1	—0.3	—0.2	+0.50
	7/5	3½ S	+0.75	2.8		III					—2	—0.7	—0.4	+2.00
	7/12	5½ S	+0.75	4.5		III					—3½	—0.8	—0.8	+2.00
	7/21	6¼ S	+0.50	4.0		III					—2¾	—0.7	—0.6	+2.00
R.W.	7/3	1 S	—0.25	3.0		I								+0.50
	7/6	1½ S	—0.25	3.0		I								0.00
	7/13	1 S	—0.50	4.1		I								0.00
	7/20	1¾ S	—0.37	3.1		I								+0.50
S.W.	7/5	1 S	0.00	3.3	5.2	I								0.00
	7/6	2 S	0.00	5.0		I								+0.50
	7/13	4 S	—0.25	7.0		II.III	2	0.3	0.4	+1.00	—1	—0.1	—0.2	+1.00
	7/20	¼ S	0.00	4.0		II	2	0.5	0.4	0.00				0.00
K.Y.	6/30	1½ S	0.00	12.5	8.7	II	2½	0.2	0.3	+1.00				+1.00
	7/5	2½ S	—0.25	7.8		II	1½	0.2	0.2	+1.00				0.00
	7/11	4 S	—0.12	14.0		I								+0.50
	7/18	2¼ S	—0.25	9.5		II	5¼	0.6	0.6	+0.50				0.00
	11/9	2½ S	—0.50	10.8		II	1½	0.1	0.2	+1.00				0.00
	11/12	2¼ S	—0.50	22.00		II	2	0.1	0.2	+0.50				0.00
A.Z.	7/13	1 S	+1.00	1.00		II.III	1	1.0		+1.50	—1½	—1.5		+1.00
	7/20	0	—1.00	3.0		II	2	0.7		0.00				—1.00
	7/20	¼ S	0.00	3.00		II	¾	0.3		+0.50				+0.50
S.Z.	7/19	12 S	0.00	5.3		II	1	0.2		+0.50				0.00
	7/19	16 S	2.00	2.5		III					—6	—2.4		+2.00
	7/21	10 S	—0.50	7.3		I								+2.00

lenses. Column 9 indicates the calculated accommodative change corresponding to the convergence change shown in Column 8. The measured slope of each curve (Column 5) was used in this calculation. Column 10 shows the change (increase) in accommodation as calculated with the haploscopically determined A.C.A. ratio (Column 6). The ordinate value of Point B, the point at which the "knee-back" occurs, is given in Column 11.

Columns 12 through 14 relate to curves with Group III characteristics. The maximum decrease in convergence induced by the added plus lenses is shown in Column 12. The minus sign denotes a decrease in convergence. The data in Columns 13 and 14 were calculated exactly as the data of Columns 9 and 10, respectively. The minus sign indicates that accommodation apparently relaxed with the addition of the plus lenses.

Column 15 gives the ordinate value of Point C, the datum point representing the minimum convergence.

Table II shows the means and standard deviations of the relative changes in convergence and accommodation induced by the added spherical lenses. Only the data for the thirty subjects with normal binocular vision were used in preparing this table as well as in all further analyses of results.* Using the mean data from Table II it was possible to construct curves for each of the groups (Figures 3 and 4).

DISCUSSION

RELATIVE INCIDENCE OF CURVE TYPES

The nature and degree of the variations in the heterophoria measurements induced by the added plus lenses formed the basis for the classification of the curves into groups. Group I curves were the most frequently obtained. These curves reveal that convergence and accommodation remained essentially unchanged with the addition of plus lenses. About one-half of the total number of eighty-nine curves were in Group I. Twenty-two out of the total of thirty subjects demonstrated this kind of response at least once (Table III).

About one-third of all the curves were classified as Group II curves and were distributed among fifteen of the thirty subjects (Table III). For the Group II responses an average of 1.5△ of convergence and 0.3 D. of accommodation were apparently activated with both the +2.00 D. lens addition and the —0.50 D. lens addition (Table II, and Figures 3 and 4). For three subjects (J. Co., S. L., and K. Y.), more than 0.5 D. of accommodation were brought into play with added

*Subjects R. J., F. K., A. Z., and S. Z., had abnormal binocular vision. Their data are presented in Table I and sample curves are shown in Figure 7.

TABLE II

According to group, the mean and standard deviation of the relative changes (i.e., relative to no lens addition) in the distance lateral heterophoria measurements (Δ) induced by various added spherical lenses (D.). Also the mean and standard deviation of the corresponding changes in accommodation (D.) as calculated by using (1) the measured slope of each individual curve, and (2) the haploscopic measure of the A.C.A. ratio. N denotes the number of trials involved in each calculation. The minus sign indicates relaxation of convergence or accommodation.

Lens Add		+0.50	+1.00	+1.50	+2.00	—0.50	—1.00	—1.50	—2.00
				Group I					
Phoria	Mean	0.0	0.1	0.1	0.0	1.5	3.6	5.9	7.7
	S.D.	0.5	0.5	0.7	0.4	1.4	2.5	4.0	4.6
	N	42	42	42	40	42	42	41	38
Accommodation (Measured Slope)	Mean	0.0	0.0	0.0	0.0	0.3	0.7	1.2	1.7
	S.D.	0.1	0.1	0.2	0.1	0.3	0.3	0.3	0.4
	N	42	42	42	40	42	42	41	38
Accommodation (Haploscopic A.C.A.)	Mean	0.0	0.0	0.0	0.0	0.3	0.7	1.1	1.5
	S.D.	0.1	0.1	0.1	0.1	0.2	0.4	1.3	0.9
	N	29	29	29	29	29	29	28	26
				Group II					
Phoria	Mean	0.2	0.6	1.1	1.5	1.6	4.1	6.0	7.3
	S.D.	0.4	0.8	0.8	0.9	1.8	3.5	3.8	5.2
	N	31	31	30	28	31	31	29	24
Accommodation (Measured Slope)	Mean	0.1	0.2	0.3	0.5	0.3	0.8	1.2	1.7
	S.D.	0.2	0.2	0.3	0.4	0.3	0.3	0.4	0.4
	N	31	31	30	28	31	31	29	24
Accommodation (Haploscopic A.C.A.)	Mean	0.1	0.1	0.2	0.3	0.3	0.7	1.0	1.3
	S.D.	0.1	0.1	0.2	0.2	0.3	0.4	0.6	0.7
	N	24	24	24	24	24	24	22	20
				Group III					
Phoria	Mean	—1.3	—1.5	—1.7	—1.8	1.3	3.5	5.4	5.8
	S.D.	0.6	1.0	0.9	1.0	0.9	1.0	1.6	3.2
	N	9	9	9	9	9	9	9	7
Accommodation (Measured Slope)	Mean	—0.3	—0.4	—0.4	—0.4	0.3	0.9	1.3	1.9
	S.D.	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.2
	N	9	9	9	9	9	9	9	7
Accommodation (Haploscopic A.C.A.)	Mean	—0.2	—0.2	—0.3	—0.3	0.2	0.7	1.0	1.4
	S.D.	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.4
	N	8	8	8	8	8	8	8	7
				Group II.III					
Phoria	Mean	—1.2	—1.1	—0.6	0.3	1.2	3.7	5.8	7.0
	S.D.	0.8	0.4	1.0	1.8	0.7	1.8	2.8	3.3
	N	7	7	7	5	7	7	7	6
Accommodation (Measured Slope)	Mean	—0.3	—0.3	—0.1	0.1	0.4	0.9	1.4	1.9
	S.D.	0.2	0.2	0.3	0.4	0.3	0.2	0.3	0.3
	N	7	7	7	5	7	7	7	6
Accommodation (Haploscopic A.C.A.	Mean	—0.1	—0.1	—0.1	0.2	0.3	0.7	1.0	1.6
	S.D.	0.1	0.1	0.2		0.1	0.3	0.5	
	N	3	3	3	2	3	3	3	2

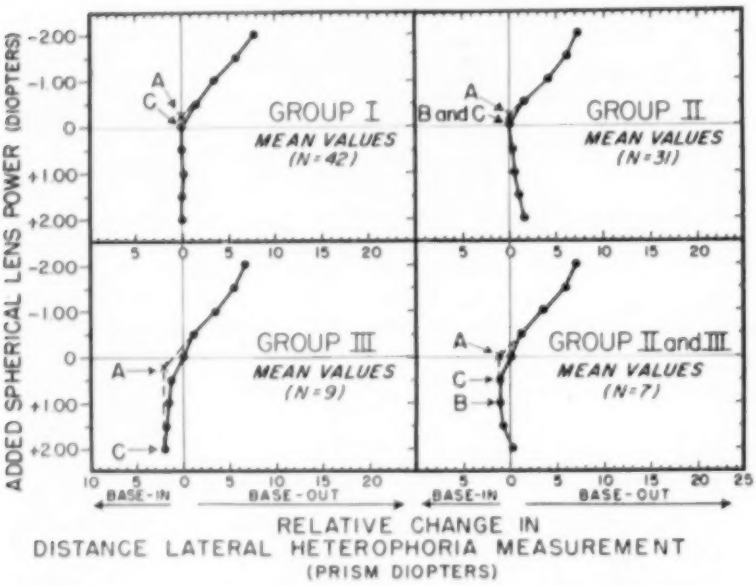

Fig. 3. Curves plotted from the mean heterophoria data in Table II and showing the relative changes in distance lateral heterophoria measurements induced by various added spherical lenses. N represents the number of curves identified in each group.

plus lenses. One of these three subjects (S. L.) accommodated 0.7 D. when a +1.00 D. lens was added. The maximum increase in convergence induced by added plus lenses was about 5△ (K. Y., 7/18).

Only about one-sixth of the curves indicate that convergence and accommodation decreased under the influence of plus fogging lenses (Table III: Group III, and Group II, III). One subject (A. W., 7/12) reacted to the +2.00 D. lens addition by relaxing 0.8 D. of accommodation and 3.5△ of convergence. The average maximum relaxation of accommodation was 0.3 D. for Group III (N = 9) and 0.1 D. for Group II,III (N = 7). Of the eleven subjects in these two groups, seven reacted to the higher plus lens additions by increasing convergence and accommodation (Group II,III). On the average this increase began to occur with an added lens of about +1.00 D. as shown in Figures 3 and 4.

It is interesting that there were so few Group III and Group II, III curves. This is particularly interesting since the refractions performed by the investigator yielded, on the average, about 0.37 D. less plus or more minus power than the refractions performed by other clinicians.

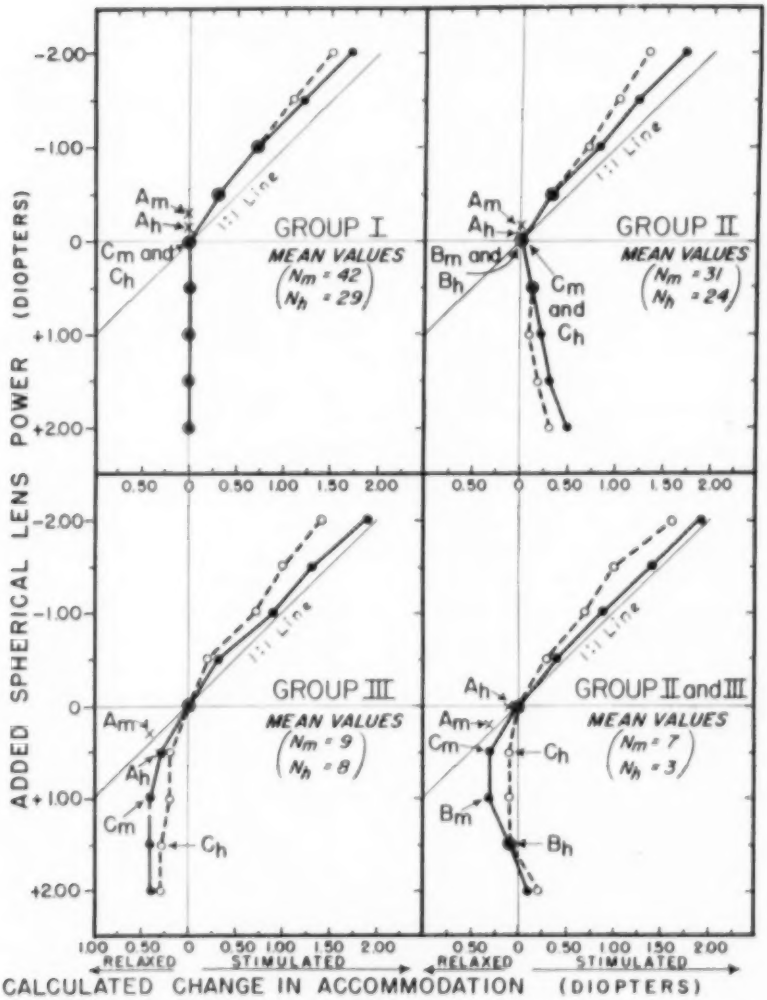

Fig. 4. Curves plotted from the mean accommodation data in Table II and showing the calculated changes in accommodation induced by various added lenses. Accommodative changes were calculated from the measured slope of each subject's curve (subscripts m, solid curves) and also from each subject's haploscopically determined A.C.A. ratio when available (subscripts h, dashed curves). The lateral separation of each curve from the 1:1 line denotes the average amount by which accommodation apparently lagged behind the stimulus. N represents the number of obtained curves in each group.

Table III
Distribution of Each Subject's Curves According to Group

SUBJECT	GROUP I	GROUP II	GROUP III	GROUP II,III
T.B.	1			
S.B.	1			
B.C.	1			
S.C.				1
R.F.			1	
B.G.				1
C.L.		1		
J.S.	1			
R.M.		2		
J.Co.	1	1		
A.B.		3		
W.J.	1	2		
A.L.	1		2	
B.L.		3		
G.T.	1	2		
R.B.	4			
P.B.	2	1		1
J.Ca.	1	2	1	
B.F.	3	1		
J.K.	3			1
S.L.	1	3		
D.M.	1	2		1
S.M.	4			
H.P.	2	2		
R.S.	4			
J.V.	2		2	
A.W.			3	1
R.W.	4			
S.W.	2	1		1
K.Y.	1	5		
CURVES, total (N = 89)	42	31	9	7
SUBJECTS, total (N = 30)	22	15	5	7

This average difference of 0.37 D. suggests that subjective refraction methods utilizing visual acuity criteria do not reveal the point at which accommodation is brought into play, but instead are biased towards more plus power or less minus power by 0.37 D. or more. Morgan[25] has found the plus bias in ordinary refraction procedures to average slightly more than 0.50 D. with limits from 0.25 D. to 1.25 D.

The three types of accommodative response to fogging lenses reported by Reese and Fry[12] have been deduced from the changes in convergence measured in the present investigation. In addition, a fourth type of response has been identified (Group II,III). The results of the present investigation fail to support the contention that added plus lenses produce maximum relaxation of accommodation when fixation is at distance. In view of (1) the plus bias inherent in routine refracting methods, (2) the relatively high incidence of Group I responses and

Group II responses ("knee-back"), and (3) the low incidence of Group III and Group II,III responses, the prudence of routinely using added plus lenses to inhibit accommodation or convergence, when fixation is at distance, is seriously questioned.

THE ADDITION OF MINUS LENSES

The slope of the curves resulting from added minus lenses and the location of Points A and C varied somewhat among the subjects and the groups. A zero ordinate value for Point C is interpretable as a verification of the subjective refraction in terms of minimum accommodation. Point A can be assumed to represent the theoretical point at which accommodative convergence comes into play, although actually it may become activated nearer Point C.

The slope of the curve resulting from added minus lenses can be taken as a measure of the A.C.A. ratio. However, this method of appraising the A.C.A. ratio appears to have the usual criticism of most clinical measures of this ratio, viz., the failure to consider the actual accommodative response of the eye. The coefficient of correlation between the slope of the curve, obtained at each of seventeen subjects' first trials, and the haploscopically determined A.C.A. ratio was calculated to be +0.49 with a standard error of 0.25 (ninety-five per cent confidence interval from +0.02 to +0.78).[26, 27] This degree of correlation compares closely with the coefficient of correlation between the gradient measurement at 33.3 cm.* and the A.C.A. ratio determined haploscopically on the same subjects, viz., $r = +0.53$, standard error = 0.31 (ninety-five per cent confidence interval from +0.10 to +0.78).

The increment of change in accommodation and (accommodative) convergence generally was greater for the higher powers of added minus lenses although some curves showed a "falling off" of these functions when —1.50 D. and —2.00 D. lenses were added. Characteristically the accommodative response to minus lenses, as calculated from the haploscopic A.C.A. ratio, was less than the apparent accommodation, as calculated from the measured slope of the curve, and both of these accommodative values were less than the stimulus to accommodation (Figure 4). This is consistent with haploscopic studies on the relationship of the accommodative response to the accommodative stimulus.[24, 25, 29]

Of interest is a related study by Asher[30] in which sixteen out of his twenty-two subjects failed to demonstrate a change in convergence,

*Using the same subjects, lateral heterophoria measurements were taken with random additions of plus and minus lenses from +2.00 D. to —2.00 D. in 0.50 D. steps. A Maddox rod and a vertical row of reduced letters were used, thereby approximating the technique employed for distance in the present investigation.[28]

as measured with a Maddox cross at six meters, when concave lenses were added binocularly to the refractive correction. If the minus lenses had stimulated accommodation in these sixteen subjects, accommodative convergence should have increased and measurable changes in the 'phoria measurements should have been detected. Absence of such changes were not observed in the present investigation. There are at least two explanations for this difference in results.

In the first place, Asher used a testing method which probably did not require accurate accommodation during the period of measuring the lateral heterophoria. He stated that (p. 670), "For each pair of lenses added, the patient announces the position of the red line, and in each case the visual acuity is checked by a Snellen chart placed on the wall. Readings are discontinued when vision had deteriorated by one line on the chart." It appears as though the visual acuity was checked on the Snellen chart *after* the 'phoria measurements were made.

Secondly, peripheral portions of the Maddox cross or its surrounds may have been visible to both eyes of the subjects by virtue of an excessively anterior placement of the Maddox rod. The presence of peripheral fusion during the testing procedure could have prevented the manifestation of changes in the heterophoria measurements even though accommodation increased with the addition of concave lenses. Attempts were made in the present study to overcome this possible difficulty by placing the multiple Maddox rod in the auxiliary clip of the phoropter and also by keeping the eye occluded constantly except for brief and irregularly spaced intervals.

RELATIONSHIP TO HETEROPHORIA

An elementary but imposing question can be asked, "Is there a relationship between the type of response to added plus lenses (Groups I, II, III, or II,III) and the lateral heterophoria measurement with no lens addition?" To answer this question, the heterophoria measurement obtained at the first trial for each subject was tabulated according to the classification of the curve at that trial. The mean 'phoria measurements by group are shown in Table IV. Using the analysis of variance[27] it was found that the differences among the means were not statistically significant ($F = 1.524$; $F_{3,26}^{0.95} = 2.98$). Hence, it can be stated that the data failed to demonstrate any systematic differences in 'phoria among the four groups.*

*Also, an analysis of variance indicated that the differences among the means of the equivalent spherical corrections (right eyes) for the four groups were not statistically significant ($F = 0.743$; $F_{3,26}^{0.95} = 2.98$).

Table IV

According to group, the mean and standard deviation of the distance lateral heterophoria measurements at the initial trials with no lens addition. N denotes the number of trials. The minus sign indicates exophoria.

		GROUP I	GROUP II	GROUP III	GROUP II,III	All GROUPS
Phoria	Mean	0.0	—1.0	+ 4.3	+ 1.8	+ 0.1
	S.D.	2.8	4.7		1.3	3.5
	N	15	10	2	3	30

THE EFFECT OF TIME

The apparent increases in accommodation which occurred with the addition of plus lenses (Group II responses) may represent a return to a state of rest in the crystalline lens according to Otero's[31] theory of negative accommodation. On the other hand, it may be that these increases in accommodation were only temporary responses which would disappear in the interest of better acuity after constant wearing of added plus lenses. The results of the present study do not answer the important question, "What effect would constant wearing of a plus lens addition have on the type of response to added plus lenses?" The answer will depend upon the results of future investigations in which the subjects will have to wear, for a considerable period of time, plus lens additions from +1.00 D. to +2.00 D. or more. The resulting reduction in visual acuity will be a practical consideration which most likely will make the investigations difficult.

Of the subjects available in the present investigation, one subject (K. Y., R.E. —0.75 D.S., L.E. —0.50 D.S.), who rather consistently demonstrated a Group II response, later volunteered to wear a pair of +1.50 D. spherical lenses for thirty consecutive waking hours (2:00 P.M. on November 10, 1951 to 4:30 P.M. on November 12, 1951). The curves obtained before and after the wearing of the plus lenses are shown in Figure 5. The curves indicate the same kind of response to added plus lenses after prolonged wearing of the lenses. After the wearing period, accommodation may have increased slightly with the addition of +2.00 D. lenses. Interestingly, the convergence responses to the addition of minus lenses were markedly greater after wearing the added plus lenses.*

*A clinical impression which relates here is the apparent tendency for uncorrected myopes to show at their initial examination an esophoria at near while wearing their full minus correction. This seems to apply also to undercorrected myopes at the examination at which the undercorrection is noted. Generally, the esophoria at near becomes reduced to a normal or near normal value following continued wearing of the full minus correction. A possible explanation for this clinical phenomenon and the phenomenon observed in subject K. Y. is that blur or excessive demands on positive fusional convergence, which are present in uncorrected or undercorrected myopia, stimulate psychic convergence which continues to be manifest when the full minus correction is first put in place.

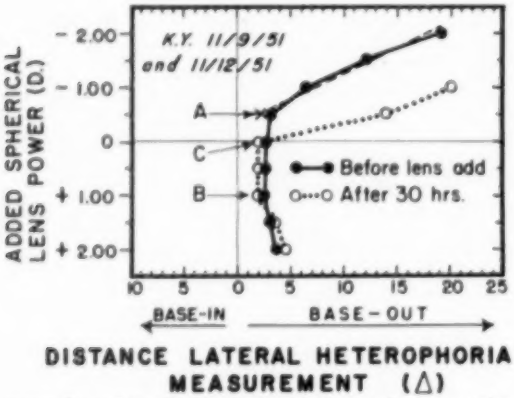

Fig. 5. The curves for subject K. Y. obtained before and after wearing a +1.50 D. lens addition for thirty consecutive waking hours. Points B and C occur at the same ordinate locations on both curves.

THE EFFECT OF CYCLOPLEGIA

For those subjects in whom accommodation apparently relaxed with added plus lenses, the question arises as to the meaning of the subjective refraction as a test. The test cannot have disclosed the refractive state of the eye if accommodation was still acting. Careful analysis of the curve for subject B. G.* (Figure 2) provides information of particular interest in this regard.

With a —2.00 D. lens addition in place, the esophoria measured 12△, whereas there were only 7△ of esophoria with a —1.00 D. addition. Therefore, a decrease of 5△ of convergence was associated with a relaxation of about 1.00 D. of accommodation, assuming the accommodative response approximated the stimulus. Reducing the minus lens addition from —1.00 D. to zero only reduced the 'phoria measurement by 4△. Hence, accommodation probably relaxed only four-fifths as much as for the previous 1.00 D. change in lens power. These calculations are based on the probable constancy of the A.C.A. ratio for any given subject.[15, 18, 32]

The addition of a +1.50 D. lens reduced the esophoria by 2△. Therefore the change in accommodation was in the ratio of 2△/5△, or about 0.4 D. of accommodative relaxation. This maximum relaxation of 0.4 D. must mean that 0.4 D. of hypermetropia were present. To test this proposition, a cycloplegic refraction was performed. One drop of a four per cent solution of homa-

*A +0.25 D. lens addition before the right eye consistently reduced the visual acuity at distance.

tropine hydrobromide was placed in the lower cul-de-sac of each eye every five minutes for twenty minutes. When the subject could no longer read reduced Snellen letters of 5 mm. height at a distance of 50 cm., distance lateral heterophoria measurements were taken. The obtained data were plotted on a graph which is shown in Figure 6.

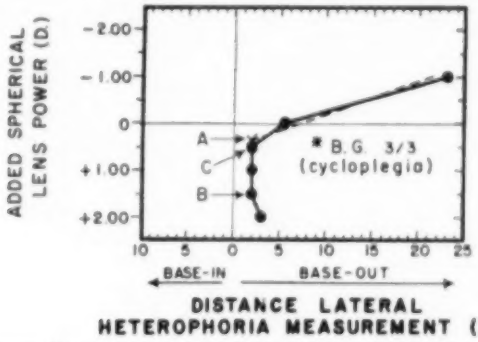

Fig. 6. The curve for subject B. G. obtained following instillation of a four per cent solution of homatropine hydrobromide. The ordinate locations for Points A and C suggest approximately 0.40 D and 0.50 D. of hypermetropia, respectively. The asterisk indicates the subject supplied his own refractive data.

The Points A and C are seen to be located at ordinate values of +0.4 D. and +0.5 D., respectively. The slope of the curve, resulting from added minus lenses, increased from 5△/1.00 D. (without cycloplegia) to 14.5△/1.00 D. (with cycloplegia) indicating that with the cycloplegia approximately three times the usual neural activity was required to produce a given increase in accommodation.

Eventually the subject reported that a —0.25 D. lens blurred his distance vision. A subjective refraction was then performed. An artificial pupil was not used. The results were: R.E. +0.50 D.S. = —0.50 D.C. × 10, L.E. +0.75 D.S. = —0.50 D.C. × 180. The spherical equivalent (the average of the spherical powers required in the two principal meridians) of the correction for the right eye was +0.37 D. This agrees fairly well with the amount of hypermetropia predicted from the curves obtained before and during the cycloplegia (Figures 2 and 6, subject B. G.).

From the data obtained from subject B. G., and the data in Columns 4 and 15 of Table I, it appears that the subjective refraction test based on the usual criteria of visual acuity does not ordinarily disclose the refractive state of the eye. Instead, this test probably measures certain aspects of visual acuity and accommodation, and possibly other visual functions as well.

SUBJECT WITH ABNORMAL BINOCULAR VISION

Four of the subjects in this study had abnormal binocular vision and therefore their data were not analyzed with the data obtained from the normal subjects. Two of the subjects (F. K. and S. Z.) had an esotropia with unharmonious anomalous correspondence. One subject (R. J.) had an intermittent exotropia. Subject A. Z. had a deep amblyopia of the left eye which necessitated the use of the Von Graefe vertical dissociation method of measuring the lateral heterophoria. The "flash" method was retained, however (see Instrumentation and Procedure). For the other three subjects, the measuring procedures were identical with those employed for the thirty subjects with normal binocular vision.

Samples of the curves for the four subjects with abnormal binocular vision are shown in Figure 7. These curves resemble those obtained from the normal subjects. There is reason to expect that, in general, the same groups of responses to this test situation would be found in patients with or without binocular vision.

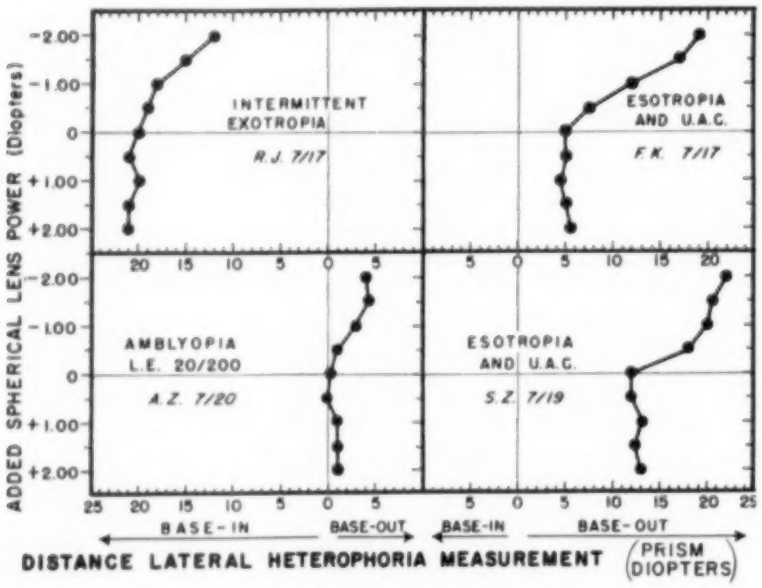

Fig. 7. Sample curves for four subjects with abnormal binocular vision obtained by plotting the distance lateral heterophoria measurement against the added spherical lens power.

CLINICAL APPLICATIONS

The instrumentation and testing procedures used in the present investigation were chosen with the idea that they could be used in an optometric office with little or no additional equipment required. The general impression derived from the results of this study is that there are a number of possible ways that the method could serve as an adjunct to the routine clinical examination.

One important application of the method is in providing a check on the validity of the refractive correction as determined by classical methods. An ordinate location of zero for Points A and C implies validation of the correction because it discloses the point at which accommodation will just be stimulated. If Point C is at zero and Point A has a minus value, it is probable that a small amount of additional minus power or small reduction of plus power would not stimulate accommodation. When Point A has a plus value, it is likely that there is an overcorrection of the myopia or an undercorrection of the hypermetropia. However, when Point A is at or near zero, the added plus power suggested by Point C is considerably less than its ordinate location (see Figures 2 and 6 for subject B. G., and also Group III curves in Figures 3 and 4).

The method can also be used as a kind of "subjective refraction" for patients with low mentality, children, malingerers, illiterates, amblyopes, and patients giving unreliable answers during the routine refraction test. In addition, the method may serve as a substitute for a cycloplegic refraction in some cases since the slope of the curve and the location of Points A and C permit ready calculation of the maximum relaxation of accommodation (see The Effect of Cycloplegia).

The suggested procedure of repeated 'phoria measurements with added lenses may also be an aid in predicting how a proposed modification of the refractive correction might affect accommodation and convergence. Additional plus or less minus power in the prescription for a patient demonstrating a Group I response probably would not relax accommodation or convergence for distance, but would only result in a reduction of the visual acuity at distance. If a patient showed a Group II response, prescribing additional plus power or less minus power in an attempt to alleviate an esophoria or esotropia may actually aggravate the condition. On the other hand, there might be justification in prescribing additional plus or less minus power for use at distance if a Group III or Group II,III curve were demonstrable. However, the amount of added plus power required to relax accommodation to its minimum may be so great as to be impractical from the standpoint of

visual acuity. Generally, it appears that a plus lens addition greater than the ordinate value of Point A would be of little benefit to the patient.

The slope of the curve can be used as an additional clinical approximation of the A.C.A. ratio and also as a validity check on the determination of this ratio by other clinical methods.

The curves obtained in the present investigation were drawn on a coordinate system similar to the one used in plotting the zone of clear, single, binocular vision (ZCSBV).[32, 33] Thus, the data obtained from repeated measurements of the distance lateral heterophoria with various added lenses can be plotted and analyzed on the same graph with the ZCSBV.

CONCLUSIONS AND SUMMARY

In a previous study by Reese and Fry[12] in which the accommodative response at distance was measured, plus fogging lenses were found (1) usually to allow accommodation to remain passive, (2) frequently to stimulate accommodation, and (3) only rarely to relax accommodation. The fixed and linear relationship between accommodation and accommodative convergence suggests that there should be three corresponding types of convergence response to fogging lenses. The results of the present investigation indicate the presence of three corresponding types of convergence response (Group I, Group II, Group III) and in addition, a fourth type of response (Group II,III) in which small additions of plus power decreased (accommodative) convergence but higher powers of plus increased it. It is believed that the convergence changes found in the present study were due to the effect of the added lenses on accommodation; it is further believed that the conclusion of Reese and Fry has been confirmed by the results of the present investigation. Moreover, the contention that plus fogging lenses induce maximum relaxation of accommodation is not supported by these results. In general, it appears that for different subjects, or for the same subject at different times, accommodation may react in at least one of four ways to the addition of plus fogging lenses. Approximately five-sixths of the eighty-nine curves plotted indicate that the fogging lenses stimulated accommodation and convergence, or allowed these two functions to remain passive.

A measure of the A.C.A. ratio can be obtained by taking lateral heterophoria measurements with minus lens additions and with fixation at six meters. The coefficient of correlation of such data with the haploscopically determined A.C.A. ratio was found to be +0.49 with a standard error of 0.25.

An analysis of variance showed no relationship between the distance lateral heterophoria measurement without any lens addition and the type of response to added plus lenses.

The wearing of added plus lenses by one subject for thirty hours was observed not to have changed his response (an increase in convergence and accommodation) to these lenses.

A cycloplegic refraction for one of the subjects revealed a degree of hypermetropia which was predicted from the curves obtained by plotting the changes in the distance lateral heterophoria measurements with added plus and minus lenses. The routine refraction without cycloplegia did not disclose this degree of hypermetropia.

The responses to added plus and minus lenses were found to be similar among subjects with normal and abnormal binocular vision.

A clinical procedure is described which has potential clinical usefulness. A few of the uses for this procedure are: (1) to provide a check on the validity of the refractive correction as determined by classical methods, (2) to serve as a kind of "subjective refraction" which may be a substitute for a cycloplegic refraction in some cases, (3) to aid in predicting how a proposed modification of the refractive correction might affect accommodation and convergence, (4) to give an additional clinical measure of the A.C.A. ratio, and (5) to assist in analyzing clinical data by plotting the resulting curve on the same graph with the zone of clear, single, binocular vision.

In view of three factors, (the plus bias inherent in routine refraction methods, the relatively high incidence of Group I and Group II responses, and the low incidence of Group III and Group II,III responses), the prudence of using added plus lenses to inhibit accommodation or convergence, when fixation is at distance, is seriously questioned.

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THE RELATIONSHIP OF THE BIRTHPLACE OF PARENTS AND GRANDPARENTS TO THE REFRACTIVE STATE OF THE CHILD*

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Los Angeles, California
and
Monroe J. Hirsch‡
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It has been suggested that the refractive state of the eye is related to several of the sociological variables. Steiger[1] felt that myopia was more prevalent among wealthier people: many authors have claimed that myopia or hypermetropia was more prevalent in one of the various ethnic groups. Duke-Elder[2] even suggests that geographic location within a country may be related to the distribution of refractive state, maintaining that there is a greater incidence of myopia in eastern than in western United States.

In a preliminary investigation[3] of the numerous sociological variables, the authors submitted a comprehensive questionnaire to a group of high school students whose refractive state had been carefully determined.** That a simple questionnaire, filled out by the respondent without assistance has weaknesses as a determinant of sociological status was understood at the outset, but it was felt that this procedure might yield information concerning those variables worthy of further consideration. Many of these results will be treated in future communications. The present paper deals with one sociological variable which did show a statistically significant relationship with refraction, namely, the birthplace of grandparents.††

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**Retinoscopy was performed by Drs. Dorothy Bergin Mellem and Charles Abel, to whom the authors express thanks, and by one of the authors (MJH). The method was that customary in screening large groups of children and has been previously described.[4] The subject, wearing +1.50 D. spherical lenses, watched a motion picture while retinoscopy was performed through a lens bar. The power in the two major meridians of each eye was determined, and the average of these four values was accepted as the average refraction.
††It should be noted that the overall study included many items. Since the statistical level which was accepted as significant was a probability of 0.05, by chance one or two of the variables should have reached this level even if no relationship existed in any of the analyses. The authors are aware of this, but have no choice other than to present the data as they were found.

THE SAMPLE

A complete description of the group is included in the original report.[3] It may, however, be briefly described for present purposes. The subjects were 600 students attending a high school in Los Angeles County. Of these, only 414 were included in the study, since the others failed to provide sufficient questionnaire data for analysis. Among these 414 were 200 boys and 214 girls, ranging from 13 to 18 years of age.

The families from which these subjects came were predominantly in the lower middle class, most of the fathers being skilled workers, with some small business operators constituting a modest fraction of the sample. The modal family income in 1951 was between 4,000 and 5,000 dollars per year. For the most part, both parents had attended or completed high school, and a few had gone to college. Almost all of the families were white, Anglo-Protestant, and chiefly Methodist or Baptist in denomination. The subjects themselves were predominantly third-generation Americans, both parents having been born in the United States in the case of 352 of the 396 students who supplied this information. Similarly, 159 of the 265 who knew the birthplace of their grandparents reported all four of them were born in the United States.

The group, therefore, was a homogeneous, lower middle class segment of the American population. This homogeneity serves to make the analysis less equivocal, but, of course, restricts any generalizations to groups of like composition.

Since the data were to be analyzed by the chi square method[5] it was necessary to group the results. If the customary grouping for refractive state of hypermetropia, emmetropia, and myopia was used, with emmetropia defined as an average refraction of zero, then few children fell into this category, a condition not satisfactory for this form of statistical analysis. On the other hand, if emmetropia were defined as any refraction between —0.50 D and +0.50 D., then, because of the leptokurtic and skewed form of the distribution, the number of myopes was not sufficient to meet statistical needs. The most satisfactory grouping, decided upon prior to the analysis, was as follows: since the mean refraction of the sample was +0.34 D., the mid-group was the mean ±0.50 D.: i.e., refractions between —0.16 D. and +0.84 D. Since these refractions are not properly speaking emmetropic, this group is referred to as the modal group. The two extreme groups include those children whose refractions were more myopic than —0.16 D. and those more hypermetropic than +0.84 D.

RESULTS

Table I shows the distribution of refractive state of the subjects according to the birthplace of their parents.

TABLE I

	Modal	Myopes	Hypermetropes	Total
Both Parents Native-Born	239	53	60	352
One or Both Parents Foreign-Born	35	3	6	44

The chi square (χ^2) calculated from the distribution is 3.184, the probability, 0.20. Thus, the observed distribution of refractive state for the factor of parental birthplace differs from a chance-expected distribution by an amount which might occur fortuitously two times in ten, and, statistically, the distribution obtained does not differ significantly from one based upon chance.

The distribution of the refractive state of the high school students as related to the birthplace of their grandparents is presented in Table II.

TABLE II

	Modal	Myopes	Hypermetropes	Total
All 4 Native-Born	101	28	30	159
1 Foreign-, 3 Native-Born	20	6	3	29
2 Foreign-, 2 Native-Born	36	2	4	42
3 Foreign-, 1 Native-Born	2	2	2	6
All 4 Foreign-Born	20	6	3	29
	179	44	42	265

The χ^2 of this distribution is 14.65, the probability, 0.07. There are, however, a number of categories in which the number of children is too few for application of this technique. The difficulty may be overcome either by applying a statistical correction (Yates Correction),[6] or by regrouping the data. The latter course seemed better in the present instance, and the data have been regrouped as follows. Analysis of the data in Table II showed that the results were similar when all four grandparents were of similar nativity, whether this were native or foreign. Thus, the data were regrouped into three categories, as shown in Table III. With regard to refractive error, the data exhibit a phenomenon often observed in studies of refraction: namely, that both extremes, myopia and hypermetropia, are affected in a similar manner. For example, in other data, Dzen[7] found that not only high myopia, but also high hypermetropia, was more prevalent among Chinese than among non-Chinese patients in Peking Medical College. Similarly, Pearson, Usher, and Nettleship[8] found that not only myopia, but also hypermetropia, was more prevalent among albinos than among the normally pigmented group. Again, most studies on Negroes have shown not only a smaller number of myopes than expected, but also a smaller number of high hypermetropes. The authors' experience in other aspects

of the present study leads to the same conclusion, and, therefore, both types of refractive error have been grouped together in Table III.

TABLE III.

	Modal Group	Refractive Errors (Myopes and Hyperopes)	Total	
All 4 Native or Foreign-Born	121 (127)*	67 (61)	188	35.6%
3 Native- or Foreign-Born	22 (24)	13 (11)	35	37.1%
2 Native-, 2 Foreign-Born	36 (28)	6 (14)	42	14.3%
	179	86	265	

(*The numbers in parentheses are the expectancies based on chance.)

The χ^2 for this distribution is 8.26, and P lies between 0.01 and 0.02. The conclusion derived from this table is that there are more refractive errors among children of homogeneous grandparental nativity than among children whose grandparents were born in different areas. This same conclusion is demonstrated if the percentage of children with refractive errors is determined for each of the three classes in Table III. If all four grandparents were either native- or foreign-born, 36 per cent of the children had either myopia or hypermetropia in excess of the degree considered in this study; if three grandparents were of similar origin, the percentage of refractive error among the children was 37 per cent. However, only 14 per cent of those children two of whose grandparents were native-born and two foreign-born had refractive states considered in this study as extreme.

DISCUSSION

Indications are present in the data of the present study that there is a greater number of hypermetropic grandchildren for the group of native-born grandparents, and that myopia prevails more among the grandchildren of foreign-born grandparents. Although these indications are not statistically significant, they are in agreement with other studies. Both Nowak[9] and Kronfeld[10] found that Europeans display relatively more myopia, whereas Americans show relatively more hypermetropia. Were one to attempt to arrive at a suitable hypothesis to explain the present data, then it would be as follows: one extreme of refraction (myopia) is relatively more prevalent in the foreign-born group, whereas the other extreme (hypermetropia) is relatively more prevalent in the native American group. Intermarriage seems to cancel the extremes of refraction, whereas marriage of those of like birthplace appears to enhance the deviation of the progeny from the modal refractive state. Furthermore, it appears to take more than one generation for this phenomenon to manifest itself, since the birthplace of the parents did not seem to be associated with the refractive state of the children, although

the number of foreign-born parents in the present sample was too small to enable any satisfactory generalizations to be made.

Further hypotheses would seem to be fruitless in view of the meager evidence for the relationship expressed. Any attempt to determine whether the relationship is based upon sociological or biological factors, or to determine the relative importance of environment and heredity, must await more complete evidence for the existence of the phenomenon. These data are being presented at the present time merely to stimulate interest in the problem and to point to a possibly fruitful avenue for further research on the genesis of refraction of the eye. Some of the weaknesses of the present study may be avoided if the following suggestions may be incorporated into future studies of this problem.

1. The refractive state should be related specifically to the country of origin and note taken of any significant post-migratory changes.
2. Such changes should also be related to the age at which emigration from the land of birth occurred.
3. Comparisons ought to be made of the refractive error of persons born in other lands with that of the children born in the same country as the parent and of the children born in the United States.
4. Account should be taken of the length of time foreign-born parents and their foreign-born children have resided in the United States, and at what age each arrived in this country.

Adequate studies of this nature might prove of asistance in the appraisal of the relative contribution of biological and social factors to the development of the refractive state.

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ASSOCIATION OF SCHOOLS AND COLLEGES OF OPTOMETRY*

JUNE, 1954, ANNUAL REPORTS OF MEMBER INSTITUTIONS

Committee on Textbooks and Publications†

SCHOOL OF OPTOMETRY, UNIVERSITY OF CALIFORNIA

The new School of Optometry building, which has been completely occupied by us for a little over a year, has more than exceeded our hopes in almost every way. All activities of the School—teaching, clinical, and research—have been markedly improved by the new facilities.

The University of California School of Optometry has had a marked reduction in enrollment. At present we have twenty junior students, twenty senior students and twenty graduate students.

For the past year, at the request of the Alameda and Contra Costa County Optometric Association, the School of Optometry staff has presented monthly educational seminars. These seminars held at the School have been so popular that they are to be reconstituted as the Educational Seminars of the Faculty of the School of Optometry to which all members of the COA are invited.

Mr. G. H. Giles, the noted British optometrist and authority on orthoptics lectured at the School of Optometry on the evening of March 29, 1954, under the joint sponsorship of the University of California School of Optometry and the Association of Schools and Colleges of Optometry.

Occupancy of the new School of Optometry building brought a marked increase in research activities. Professor Gordon L. Walls and Dr. Gordon Heath are continuing their studies of color blindness. Dr. Walls and Dr. Heath have a new theory of total color blindness which is shortly to appear in two installments in ACTA OPHTHALMOLGICA, and Dr. Walls has been invited to present a paper at the 17th International Congress of Ophthalmology in New York in September.

Professor Meredith W. Morgan, Jr. and Dr. Merton C. Flom are continuing their statistical survey of published and current results of orthoptics and surgical treatment of strabismus—the nature and sig-

*Summary of Reports presented at the annual meeting of the Association, Seattle, Washington and Forest Grove, Oregon, June 23-25, 1954. Submitted on December 29, 1954, for publication in the March, 1955, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

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nificance of "convergence accommodation" and the relationship to amblyopia of suppression and eccentric fixation.

Professor Elwin Marg and Dr. Darrell Carter are conducting a number of electro-physiological studies of the retina and of the central visual pathways in addition to an investigation of the apportionment of "fixation disparity" between the two eyes and the changes in central-fixation disparity associated with fusional movements.

Dr. Frederick W. Hebbard is continuing his investigation of physiological nystagmus in relation to target distances and the various degrees of visual acuities.

Dr. Sigmund Sabin is starting a study of the lateral geniculate body in certain members of the squirrel family.

Professor Henry B. Peters has been appointed as secretary of the inter-professional consulting committee to the San Francisco Health Department, and consultant to the Director of Health Education of the Marin County School Department in organizating a visual testing program. He has acted as a consultant to motorist vision and safety council groups and was the representative of the School of Optometry at workships on School Vision sponsored by the State Department of Education last summer.

While professional and scientific recognition of many kinds have come to members of the School of Optometry staff, we shall mention only one here—the re-election of Professor Meredith W. Morgan, Jr., to the presidency of the American Academy of Optometry.

CHICAGO COLLEGE OF OPTOMETRY

During the preceding year, the construction of our new college building in "Technology Center" was begun, and we will move into the building in time for the beginning of the 1954 fall semester. Housing for C.C.O. students is being provided in the dormitories and apartment buildings of Illinois Institute of Technology less than a block away.

A three-story brick apartment building two doors south of the new college has been remodeled into the south side branch of the C.C.O. eye clinic. Until the new clinic grows large enough in patient volume to meet the teaching requirements of the college, C.C.O. will continue to maintain its present very busy clinic on the North Side at Clark and Belden.

Rapid development of the new clinic, under the direction of Dr. H. S. Wodis, is anticipated. Arrangements have been completed with Illinois Institute of Technology to have the clinic officially designated to serve the eye needs of the students and the staff of the Institute.

All new students at I.I.T. will be given a thirty-minute visual screening examination. Practically the entire faculty and student body of Chicago College will be needed to complete the tests in the two days allotted by I.I.T.

During the past year we have set up the following co-operative program in liberal arts and optometry.

By special arrangement with certain liberal arts colleges, including Roosevelt College of Chicago, a six-year combined curriculum in liberal arts and optometry has been established at Chicago College of Optometry. The new combined curriculum, or "professional option" in optometry, now makes it possible for the superior student to earn a bachelor's degree in liberal arts and sciences by completing three years in the liberal arts college and the first two years of the professional curriculum at Chicago College of Optometry. Upon the satisfactory completion of the 5th year of the combined curriculum, the student who has elected the "professional option" will receive his bachelor of arts or science degree from the cooperating liberal arts college. Upon the satisfactory completion of the 6th year of the combined curriculum, he will receive his professional degree, Doctor of Optometry, from Chicago College of Optometry.

During the first three years of study in the liberal arts college, the student in the conjoint program will be expected to meet the minimum requirements for admission to Chicago College of Optometry, and also to meet the specific requirements for graduation from the liberal arts college in a specified department, exclusive of the work normally required in his senior year in liberal arts. The specific requirements for graduation in both liberal arts and optometry will vary with the cooperating institution. Certain liberal arts colleges prefer to work out the conjoint program for their students on an individual basis.

COLUMBIA UNIVERSITY SCHOOL OF OPTOMETRY

Though not a formal activity of the school, members of our staff conducted an organized lecture series for groups of practicing optometrists. These were Dr. Arnold Silverstein for a group in upper New York State and Dr. Daniel Woolf for a New Jersey group under the auspices of Rutgers University.

Professor Bechtold announced designs for a new series of microscopic spectacles which are now available through the department. A new series of telemicroscopic spectacles is under development.

Our subnormal vision clinic has grown to where it now constitutes a sustained program five afternoons each week.

Our pathology clinic has been extended under the guidance of Dr.

Spivack to a program occupying five afternoons per week plus a visiting schedule at the East Side Welfare Dispensary.

The contact lens clinic has grown to a five afternoons per week program.

The program of Senior Projects has been intensified and developed into the beginnings of a substantial research program.

The Columbia Optometry Placement Service, in association with the course in Optometric Economics and Practice Management, can now offer to each graduating student a specific opportunity in a professional environment. Sufficient opportunities are in hand to do the same for recent graduates back two or three years, so that there is no need for these men to accept commercial employment.

Our two day Bicentennial symposium on The Role of Vision in the Acquisition and Utilization of Knowledge was acclaimed an outstanding event.

About March 22, the University Administration announced their decision to terminate instruction in optometry by June, 1956, when our currently enrolled students will have graduated.

UNIVERSITY OF HOUSTON COLLEGE OF OPTOMETRY

The second year of operation of the College has been a busy one for all concerned, and has been a year in which a great deal of visible progress has been made. Most significant to us, we occupied new quarters in the Science Building and in the Psychology Building. Other evidence of the growth of the College was the opening of the Optometry Clinic.

In support of the optometry program, the Texas Optometric Association contributed its third $20,000 check to the University of Houston in May.

The total enrollment in the College now stands at 26, 13 in each of the first two classes. The number of applications on hand indicates that a significant increase may be expected when the third class enters in September of this year.

Considerable progress has been made in the holdings of the optometry section in the University library. This section now contains approximately 400 volumes, many of which have been contributed by interested individuals.

During the past year the vision laboratory was equipped at a cost of approximately $12,000. This laboratory is located in the new Psychology Building, where other facilities are available and opens the way for studying many phases of vision and for the future development of a research program.

When completed next Fall, the Optometry Clinic will contain ample facilities for providing clinical experience in refracting, orthoptics and visual training, dispensing and fabrication of spectacles, and studying pathological conditions of the eyes. In addition, it is anticipated that a limited amount of clinical work will be carried out in the fields of contact lenses, subnormal vision, and aniseikonia.

The College, as well as the University, is appreciative of the excellent cooperation and kind assistance of the various A.S.C.O. member institutions in establishing the optometry program.

INDIANA UNIVERSITY, DIVISION OF OPTOMETRY

The first class in the newly established Division of Optometry started on September 21, 1953, with nineteen students enrolled. Sixteen of these have satisfactorily completed the full year's work. From the number of applications now in process it appears as though our next entering class will be about the same.

The optometry faculty included Associate Professor Merrill J. Allen teaching physiological optics, Professor H. W. Hofstetter teaching geometric optics, and Associate Professor J. S. Rafalko teaching optometric anatomy. Newly appointed faculty members are Dr. Neal J. Bailey and Dr. Ingeborg Schmidt, both as Assistant Professors of Optometry.

Our facilities include office space in the Medical Building and about 3,500 square feet of laboratory space on the ground floor level of the Student Health Center. We are assured of additional quarters for the year 1955-56 when the total curriculum will be in operation. The present quarters house the laboratories for physiological and geometric optics and a workshop for laboratory and research instrumentation.

The anatomy laboratories and facilities are integrated with those of the medical and dental schools. An important innovation in the optometric anatomy course is the use of monkey cadavers to supplement human and other anatomic materials.

Emphasis has been continued on the development of an adequate library collection. The librarians of several of the other optometry schools have been most helpful in providing periodic lists of suggested publications for acquisition.

A graduate program leading to the Master of Science degree in Physiological Optics has been established in the Graduate School. This program is designed to attract superior students from all of the accredited schools and colleges of optometry. As soon as appropriate, the graduate program probably will be extended to lead to the Ph.D. degree.

Our student procurement program has been integrated with the established orientation and vocational guidance program of the university. Representatives of the Division of Optometry now participate regularly in High School Day programs, Orientation Day programs, and the like. A full page of the attractive and widely distributed Indiana University publication entitled THE EDUCATED WOMAN is devoted to optometry as a career for women.

A weekly journal review seminar has been organized for the optometry faculty and others interested in vision. Frequent participants include representatives from psychology, anatomy, and ophthalmology. Members of the optometry staff also participate regularly in the School of Medicine seminars, and have contributed to scientific and professional journals, to educational programs for the profession, and to related civic programs.

In April, the Indiana Optometric Association again held its mid-year meetings on the university campus. This was held simultaneously with a conference program featuring Mr. G. H. Giles of London, England, as guest speaker.

The optometrists of Indiana have continued their drive to raise funds for the university. The total pledges and contributions now exceed $70,000.00. This is in addition to the automatic annual contribution of $17.00 from every optometrist licensed in the State of Indiana.

THE LOS ANGELES COLLEGE OF OPTOMETRY

FIFTY YEARS WITH VISION. The Los Angeles College of Optometry is celebrating its Golden Anniversary during the academic year 1953-54. Several events have been planned and to date three have been fulfilled.

Ten men who pioneered the establishment and growth of the Los Angeles College of Optometry were honored at the Pioneer Banquet held the evening of March 27. The men honored were Drs. W. S. Cherington, Harry L. Fuog, Joy G. Goodsell, Arthur Hoare, Ernest A. Hutchinson, Louis H. Jaques, Sr., William M. Ketchum, William M. Kinney, Leslie Scown and Lynn F. Sherman. The same weekend the Golden Anniversary Open House was held at the college. Mr. G. H. Giles, of England, also took part in the celebrations.

The second event of the Golden Anniversary Celebration was the Semi-Centennial Convocation held on Saturday, June 12. Four distinguished men addressed the Convocation: Edwin D. Fletcher of the Motor Vehicle Department of the State of California, Dr. Henry W. Hofstetter, Director of the Division of Optometry at Indiana University, Dr. Hugh C. Willett, President, Los Angeles Board of Education, and Dean-Emeritus Ralph S. Minor of the University of California.

The Golden Anniversary Commencement was held the following day, June 13. The principal speaker was the President of the American Optometric Association, Dr. James Wahl. His message was a tribute to the profession and to the young men entering the profession in the month of June.

The 1953 Commencement was also held on June 13. One Postgraduate Doctor of Optometry degree, four honorary degrees and seventy-eight Doctor of Optometry degrees were awarded.

During the summer of 1953 Dr. Monroe J. Hirsch left the institution to go into private practice in Ojai, California. In many ways, his leaving was a great loss to the College.

At the end of the academic year, 1952-53, Dr. Frederick G. Reynolds resigned due to the increase in his practice. Dr. Reynolds was the first ophthalmologist to teach in an optometric institution in this country. The California Optometric Association has commended him upon his work.

During the summer of 1953, Dr. Stuart H. Fisher came to us from an active practice in London, England. He brings a refreshing and vital outlook on optometry from another country. He is teaching geometrical and mechanical optics. Dr. Leo Schwartz replaced Dr. Frederick Reynolds as one of our staff ophthalmologists. Dr. Leo Schwartz has brought to his classes an enthusiasm which has been quickly transferred to his students.

In the beginning of the academic year the College established the office of Executive Secretary. This office is to handle all publicity and public relations as well as to act as advisor to all publications of the College. The same individual is to act as Executive Secretary to the Alumni Association of the Los Angeles College of Optometry. The man chosen to fill the important post was Mr. Mel Griggs.

Mr. Lee Farlee was added to our staff to handle all the instruction and supervision in the student mechanical optics laboratory.

Last April, Dr. Leslie Scown celebrated his 30th year of teaching with the institution. His contributions to optometric education is one of the shining lights of optometry and the profession will always look to this man as one of the pioneers of optometry. Dr. Scown has announced his retirement from active teaching. He is now professor-emeritus.

The new class admitted in September had 59 members. Total enrollment at that time was 195 students: 59 in the first professional year, 53 in the second professional year, and 76 students in the third professional year. We have seven special students. Of the total enrollment five are women.

The slogan FIFTY YEARS WITH VISION carries with it a note of humbleness as well as pride. Pride in the part that the College has played in the development of optometry in the last fifty years and humbleness in that it may continue to contribute toward its development in the fifty years ahead of us. May the people who are responsible for the direction and policies of the College have the strength and guidance to fulfill this wish.

THE MASSACHUSETTS COLLEGE OF OPTOMETRY

1954 marks the 60th anniversary of the founding of the College. The school, founded by Augustus A. Klein, M.D., had its beginning as the Klein School of Optics. It was originally established to train physicians in refraction, mechanical optics, and the recognition and treatment of unhealthy eye conditions. In 1909, the school was reorganized, expanded, and incorporated as the Massachusetts School of Optometry. In 1946, after the death of the late Theodore F. Klein, the school was again reorganized and plans made for a change in the administrative and academic status of the school. Between 1946 and 1950, the school was authorized by the Board of Collegiate Authority to change its name to the Massachusetts College of Optometry and the right was granted to confer the Bachelor of Science in Optometry and the Doctor of Optometry and the Doctor of Ocular Science.

In the fall of 1953, the College established a Speakers Bureau under the direction of Dr. Arthur March. This has met with considerable success and members of the faculty have been invited to participate in local, state, and regional educational meetings.

The College, together with the New England Council of Optometrists, co-sponsored the first occupational vision seminar in this area. The program was under the direction of Dr. David MacFarlane, instructor in Occupational Vision. The two-day seminar was attended by 51 optometrists.

The College has arranged with Suffolk University, a member of the New England Association of Colleges and Secondary Schools, for the offering of a pre-optometry program of study designed to prepare students for admission to schools of Optometry. The pre-optometry curriculum will be listed in their bulletin of information along with pre-professional curricula in medicine, dentistry, law, and engineering. The College is responsible for having established similar pre-optometry programs at Worchester Junior College and Cambridge Junior College.

In January of this year, Dr. William Smith, instructor in Corrective Optometry, released his second edition of *Clinical Orthoptics*. Two teaching textbooks are currently in the process of preparation.

Robert Berk, M.A., instructor in Visual Psychology is preparing a textbook of visual psychology, and Dr. Frank Kozol, is preparing a laboratory manual on fitting and adjusting eyewear.

The facilities of the College Clinic have been expanded to meet the increased demand for orthoptics and vision training. Since September, 1953, this department has handled over 4,000 patient-visits. A large percentage of patients referred for training came from practicing optometrists and ophthalmologists. To meet the increased demand for this service, this department will require further expansion this fall.

The College continues to maintain refraction departments for student practice in the Medical Mission Dispensary, the Boston Evening Clinic and Hospital. Our fourth year students were also admitted to the New England Medical Center Orthoptics Department where they receive training in corrective optometry under the direction of Dr. William Smith.

In order to provide our students with additional training in the recognition and management of ocular pathologies, the College has arranged with three ophthalmologists to allow our fourth year students to study cases with them in their private offices as well as in medical eye-clinics and hospitals. This plan has worked with such satisfaction that the College plans to make similar arrangements with other ophthalmologists.

Senate Bill 700, introduced into the General Courts of the Commonwealth of Massachusetts, provides for the establishment of a compact between Massachusetts and other New England States for the purpose of setting up a New England Board of Higher Education. The aim of the bill is to promote higher education in the fields of medicine, dentistry, veterinary medicine, public health, and professional, technical, scientific, literary, and other fields. While the word optometry is omitted, it is inferred either under professional or technical fields. We have been assured that the word optometry was not intentionally omitted but rather overlooked. We are endeavoring to have the bill amended by adding the word "optometry." If this is not possible, the College plans to arrange for the introduction of a bill at the next assembly which will add the word "optometry" to the present bill.

THE NORTHERN ILLINOIS COLLEGE OF OPTOMETRY

A new project to be known as "The Center for Advanced Studies in Visual Performance" is now under way. Through a grant from D. B. Harmon & Associates, a model classroom will be built and equipped. It will have an exterior wall of glass block, indirect lighting, modern chalkboards, color painting, and air conditioning. A viewing

amphitheatre is to be constructed across one end of the room with a one-way window allowing students and professional people to observe undergraduates, instructional staff, and research personnel working with patients. The Center will be utilized by educators, as well as by optometrists, ophthalmologists, psychologists, lighting and color engineers and others.

In keeping with its policy to maintain up-to-date methods of examination and treatment, the Clinic recently has added television equipment to its Visual Training Department for use in research and teaching. The Contact Lens and Sub-Normal Vision Departments have been enlarged.

Last winter, Northern Illinois College of Optometry and the Chicago Lighting Institute co-sponsored a course entitled "Lighting and Seeing in the World Today." Each of the 20 two-hour sessions was conducted by two specialists—one from the College and the other from the lighting field. A similar course is projected for the coming year.

Requests for lecturers through our Speakers Bureau reached an all-time high this year. Faculty members have addressed audiences, service clubs, and educational seminars. Several of the faculty have written articles for optometric journals. An NICO professor is currently conducting a study on vision in the field of child growth and development.

The Library of the College, which contains nearly 3,000 volumes, has been used throughout the year by optometrists. The collection includes volumes on optometry, visual science and related fields, and an indexed reference file of optometric journals and allied periodicals.

In September, 1953, the College granted a full tuitional fellowship. The two tuitional fellowships which have been available for the past three years are again offered. For the first time, the College offers two $300 scholarships annually to outstanding students. The scholarships are renewable if a 3.0 scholastic average is maintained. Also, additional sums have been contributed to the student loan fund by faculty, graduating classes, and Alumni. These funds are made available to students without cost to them.

More than 300 NICO graduates have affiliated with the Alumni Association during the past year, bringing the total to well over 1,100 members.

Two classes have graduated—one in January, the last mid-year class, and one in May. Since September, 1951, only one new class has been admitted to the College each year. Honorary degrees were bestowed upon the following four men: Dr. Clarence Strobel, vice president of the I.A.B. and member of the Illinois State Board; Dr. Alfred Rosenbloom, professor at NICO; Dr. Walker Matthews, member of the

Board of Trustees at NICO and past-president of the Alumni Association: Dr. Joseph Tiffin, Professor of Industrial Psychology, Purdue University.

SCHOOL OF OPTOMETRY, UNIVERSITY OF MONTREAL

The School of Optometry is located in the University building and is under the jurisdiction of the University Council Board. To be admitted to the School of Optometry the students must have a B.A. degree or the equivalent.

A three-year program is given in professional optometry leading to the degree of L.Sc.O. (License in Optometric Sciences).

Courses are given in French although most of the recommended textbooks are in English. The student may ask questions in English. He is also allowed to write his examinations in English.

The courses of instruction are given on the following subjects.

First Year: General anatomy and dissection, general biology, applied optics, geometrical optics, physiological optics, physical optics, theoretical optics.

Second Year: Visual analysis and orthoptics, history and deontology, histology and ocular physiology, public hygiene, myology, applied optics, physiological optics, applied optometry, general pathology, practical physics, general physiology, psychology, statistics, occupational vision.

Third Year: Visual analysis and orthoptics, pathology clinic, optometry clinic, orthoptics clinic, dispensing, contact lenses and prosthesis, applied optics, economy and jurisprudence, ocular pathology, psychology of vision, visual rehabilitation, subnormal vision, clinical dissertation and thesis.

On the graduation day which is always the first Friday of June, the University of Montreal granted the degree of L.Sc.O. (License in Optometric Sciences) to the students who have successfully passed their final examinations. They are also entitled to practice optometry in the Province of Quebec without any other examinations as long as they have a regular immatriculation. It is the intention of the Board to ask the University to grant the degree of Doctor of Optometry.

We graduated only 14 students this year. The enrollment has dropped about 35% in the last three years. This year we had two graduates from the Massachusetts School of Optometry who have followed a one year post-graduate course and returned to practice in the United States. It is our intention to set up a refresher course for the optometrists, which will last about two weeks every year.

A few changes have been made on the Board: Dr. J.-Armand

Messier has been appointed Dean and Dr. Edgar Lussier, secretary of the Board. Dr. Yves Papineau has also been nominated a member.

For information as to general admission apply to the Dean, Dr. J.-Armand Messier, School of Optometry, University of Montreal, Montreal, Canada.

SCHOOL OF OPTOMETRY, THE OHIO STATE UNIVERSITY

The Director of the Clinics, Dr. V. J. Ellerbrock, has emphasized the development of two phases of our clinical activity, aniseikonia and subnormal vision. Dr. Jack Albright and Dr. Victor Barricklow have been put in charge of these two special clinics. Under Dr. Ellerbrock our program of post-graduate courses for practicing optometrists has been expanded.

One of the highlights of the year was the visit to our school by Mr. G. H. Giles, who gave us a better insight into the practice of optometry abroad, much information and many fresh points of view. The Institute for Research in Vision sponsored a lecture by Dr. Ragnar Granit from Sweden. With assistance from the Optometric Extension Program, the University again held its annual Conference on Vision in which psychologists, physiologists, zoologists, physicists, engineers, and optometrists participated. Dr. Renshaw was in charge of arrangements for the conference.

During the year Dr. Arthur Culler, chairman of the Department of Ophthalmology and also chairman of the National Interprofessional Committee on Eye Care, suffered a ruptured aneurism and his inability to participate in affairs of the University has been seriously felt.

A research project on chromatic adaptation, sponsored by the office of Naval Research has been completed.

Dr. Neal J. Bailey, a Fellow of the American Optometric Foundation, has been awarded the Ph.D. Degree. His research concerns the space perception of squinters.

A proposal for a six year program in Optometry leading to the O.D. degree was submitted to the Secretary of the College of Arts and Sciences, who referred it to the Dean of the College of Arts and Sciences inasmuch as it involved major policies. The program submitted made six years the minimum requirement for the O.D. degree, which would be the first degree. Dean Fullington and Associate Dean Fuller, after discussing this proposal with various people at the University and with the Ohio State Board of Optometry, concluded that it would be better to organize the program so that it would lead after five years to a B.S. in Optometry, followed by an optional sixth year leading to a professional doctorate degree. This would qualify a graduate from the five year

program to practice Optometry in most states. No commitment was made in regard to whether the request for a professional doctorate degree would be supported.

The five year program would continue essentially as it now stands. The additional year leading to the professional doctorate degree would provide for additional clinical training, specialized training in contact lenses, subnormal vision, aniseikonia, etc., which would not be provided in a five year program. Furthermore, it would provide for more detailed specialized training in vision in industry and vision in schools and similar applied problems in optometry. More intensive work in the field of illuminating engineering and human engineering could be given.

COLLEGE OF OPTOMETRY OF ONTARIO

The 1953-54 season has been one of re-evaluation and re-adjustment at the Ontario College. The final class in the three year program graduated in May, 1954. During the season the staff met regularly to co-ordinate and revise the curriculum for a new improved course in Optometry.

The revised course has an admission requirement of two years of pre-Optometry. The first year is taken at one of the collegiate Institutes (Grade XIII in Ontario) and the second year at a recognized University. This is followed by a three year course at the College. The subjects in the professional part of the course have been re-arranged, course material outlined, and careful revision of course content made in order to avoid omission or duplication. The course draws heavily on the basic sciences of geometrical optics, physiology, anatomy and physiological optics. All instruction is to be based on small group discussion and laboratory work, rather than on traditional lecture presentation. It is anticipated that the group participation will mean that the student has a better grasp of the fundamentals of his profession. Further, it is hoped that this will be carried over into the clinical year in order that the student will be able to understand the physiology underlying the abnormalities he encounters.

A vigorous student procurement program has been started in which every university student in Canada who is enrolled in a non-professional course has been contacted. The cooperation of the various provincial associations has been solicited with excellent response to date.

In the matter of extra-curricular lectures the staff has provided speakers to optometrical groups in various areas of the province. It was a pleasure to have Mr. George Giles of England with us for a well-attended lecture on May 3. Many favorable comments were received from those who attended.

PACIFIC UNIVERSITY COLLEGE OF OPTOMETRY

During the past year a number of changes and additions were made in the curriculum to increase the effectiveness of our educational program. These are listed as follows:

An additional semester of clinical experience and dispensing was provided in the second semester of the fourth year. A course entitled Optometric Case Analysis and Remedial Procedures was given concurrently. To provide the clinical patients for this expanded program, the University Administration has arranged that each university student should have a visual examination each year during his under-graduate studies.

For more adequate supervision of clinical practice the teaching schedule is undergoing revision to make more of the staff available to clinical students and to bring in private practitioners during the clinic hours.

A colloquium for last semester clinical students has been provided in which their cases and problems are discussed with the staff.

$1,000.00 has been allotted to cover the cost of a working unit of a system for filing clinical case records, which will accomplish the following: (1) Record the case record on microfilm filing cards. (2) Provide a punch card analysis of the visual characteristics of each case record. (3) Make possible the projecting of the microfilmed case record for class room lecture use.

In the Mechanical Optics area a full time instructor has been authorized. His duties will be as follows: (1) Teach all formal course material and conduct all laboratories. (2) Supervise the mechanics of frame fitting, prescription writing, and dispensing in the out-patient clinic. (3) Supervise the fabrication of prescriptions by clinical students for their patients. (4) Maintain the Mechanical Optics laboratory and the supply of ophthalmic materials.

An additional semester's instruction in physiological optics and a review for state board examinations have been added.

Fifteen experimental projects at an undergraduate, graduate and staff level have been in process or were completed. Papers were published in the JOURNAL OF THE OPTICAL SOCIETY OF AMERICA, the ARCHIVES OF OPHTHALMOLOGY and by the Optometric Extension Program.

One or more members of the staff have attended approximately 20 regional and national meetings of the profession and allied fields.

In student procurement we have accomplished the following: (1) An expanded scholarship program. (2) Preliminary meetings to organize our alumni.

Progress has been made toward increasing the resources of the College of Optometry. Approximately $3,000.00 worth of visual training, pathology and mechanical optics equipment has been added. Numerous donations of equipment and library material have been received. A Poser slit lamp was contributed by the graduating classes of June, 1954, and January, 1955, through the generosity of the Bausch & Lomb Optical Company.

When the College of Optometry was moved to Jefferson Hall the building was practically devoid of furnishings. The past year we have decorated and furnished three of the consultation rooms through donations of the women's auxiliaries of the Oregon and Washington State Optometric Associations, in cooperation with one of our local business men. Other equipment has also been added.

During the past year we have graduated 59 students and admitted 49. Our enrollment during the spring semester of 1954 was 43 pre-optometry students and 125 students in the professional school.

At the 1954 Commencement of Pacific University, Dr. W. B. Pleything (O.D., 1952) was awarded the degree Master of Science with a major in clinical optometry. This is the first academic Master's degree to our knowledge to be awarded in this field.

THE PENNSYLVANIA STATE COLLEGE OF OPTOMETRY

In later years, when we look back upon the year 1953-54, we will be able to regard it as one of the most important years in the history of the Pennsylvania State College of Optometry. In April, 1954, the College was notified of its accreditation by the Commission on Institutions of Higher Education of the Middle States Association of Colleges and Secondary Schools and of its acceptance into membership in that Association.

P.S.C.O.'s acceptance by this important regional educational Association marked a new era in optometric education and optometric prestige. P.S.C.O. can again claim leadership in furthering the professional relations of optometry because it is the first independent health professional educational institution to be accepted by the Middle States Association or any other regional educational association. Prior to 1954, provision for membership in this organization was made only for Universities and Colleges of Liberal Arts and Sciences. When the opportunity presented itself, P.S.C.O. submitted an application.

Membership in the Association is very valuable and even the process of qualifying for membership is beneficial. After submitting its application, the applying institution must answer an extensive and intensive questionnaire on every phase of its operation. In our case, we had

a committee prepare the original draft of the replies. This made up 52 typewritten pages. Then, we had a copy of the original draft submitted to every member of our faculty with a request for suggestions for making the report describe our institution more accurately. The result is that today our faculty members know more about the overall structure and functioning of our total institution than ever before. Such knowledge makes it possible for faculty members to integrate their individual work into that of the institution. And, if we had any uninformed faculty member who surmised that any area of the institution has been operated contrary to high standards, the facts were clearly placed before him. Such activity certainly provides a boost to the morale of professional employees and promotes cooperative efforts in the work of an institution. We are proud of our membership in the Middle States Association of Colleges and Secondary Schools which is the largest of the regional education associations. We, and thus optometry, will derive many benefits from our membership in this organization during the years to come.

A very important project, a thorough curriculum study, in conjunction with the six year program, was planned for the 1953-54 year, but was delayed by the work of preparing for evaluation by the Middle States Association of Colleges and Secondary Schools. However, a faculty committee of five members with the Dean and Registrar as ex-officio members has started upon this work. The Committee has obtained a number of suggestions for revision of the curriculum from faculty members, graduates of the College of the past five years and present students as the result of direct letters. The suggestions from these three sources are being tabulated and will be evaluated by the entire committee at its next meeting. A deadline of December 1, 1954, has been set to have this study completed.

In November, 1953, an arrangement was made with the Department of Welfare of the City of Philadelphia to open a branch off our College Clinics in the City's home for the aged and infirm. This branch clinic has provided an increased number of patients for our senior students and an exceptional opportunity for experience with patients who present difficult problems, both from a visual standpoint and a personality standpoint, since many of these patients are mentally deficient and physically infirm.

A progress report without reference to enrollment would be incomplete. In spite of our own best efforts at student procurement and the help of the profession, we anticipate small enrollments this year and probably for several years more. Although we do not like the situation

and know that it will slow up our development, we are prepared to meet conditions as we find them. In September, 1954, we expect to enter a class of about 60, or one-half of our normal capacity.

SOUTHERN COLLEGE OF OPTOMETRY

Progress has been made during 1953-1954, both in college facilities and in instruction.

Construction continued on the new campus during the year. The Administration Building and the Library and Classroom Building now are completed. The move from Washington Avenue to the new campus will be accomplished during the coming summer, so that returning students and students entering in September will have available facilities not used previously, including a student lounge.

Curriculum improvements were effected during the year. The course sequence was modified, enhancing learning opportunities. Twenty-one courses were revised, with changes in content and in the hours assigned per week for lecture and laboratory work. The material contained in one course, Clinical Conference, was incorporated into the clinical instruction program. A second course, Contact Lens Technique, was expanded to include content dealing with aniseikonia and telescopic lenses: this course was re-numbered and re-titled. Two new courses were developed, dealing with developmental vision and occupational vision. Work in visual skills has been enhanced, with the offering now presented as a separate course. New textbooks were provided in seven courses, and new syllabi or laboratory manuals in six courses. Five of the new publications were authored by faculty members.

Additional new equipment was added in the Ophthalmic Mechanics Laboratory and in the Refraction and Visual Training Clinics. New Adjusto chairs have improved efficiency in visual training and in reading training. The Library has added 292 new titles and 68 bound volumes of magazines during the year. Recently, the Libary received the library of Dr. Weakley Ruth of Shelbyville, Tennessee, materially increasing the holdings dealing with early optometric history.

Clinical work has been intensified, with added attention given to visual training, contact lens work, telescopic lenses, and pathology. During the last year of study, each student now receives 38 weeks of clinical instruction.

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ACADEMY GRANTS-IN-AID FOR RESEARCH*

Each year the Academy makes several research grants to investigators doing research in optometry and physiological optics. The factors considered in making these grants have been set forth in a recent issue of the JOURNAL.† In Toronto this year, the Research Grant Committee recommended three projects to the Executive Council. The Council voted to make grants to these three and to a fourth project, the initiative for which arose within the Council. All four projects are already in progress and funds from the Academy will enable the investigators to continue their creditable work.

A grant of $750 has been made to the University of California Strabismus and Orthoptics Study. This major research project, under

*By Monroe J. Hirsch, Ph.D., Chairman, Research Grants Committee, American Academy of Optometry.
†Monroe J. Hirsch. Research Grant Procedure of the Academy. Am. J. Optom. & Arch. Am. Acad. Optom. 31.10.533-537, 1954.

the direction of Dr. Merton C. Flom, began in 1951 and will continue for several years more. To date, approximately 500 patients have been included in the study. The results disclosed in the first preliminary report are very encouraging, and it is anticipated that many of the basic and practical problems in strabismus and orthoptics will be solved, or at least better understood, by this exhaustive investigation. The Academy grant will be used to pay for assistance in coding, tabulating, and analyzing the vast amount of data involved in this study. The University of California School of Optometry supports the major part of the study including the operation of the Strabismus Clinic and the Orthoptics Laboratory, supervised respectively by Dr. Meredith W. Morgan, Jr., and Dr. Merton C. Flom. A series of papers ("on the Nature of Squint") based on the results and conclusions derived from this study is in preparation and will be published in this JOURNAL. The presentation of this information to the profession will be a great step forward in our understanding of human vision and its anomalies.

A grant of $337.97 was made to aid in the preparation of a dictionary of visual science. This is a major project which has been under way for the past seven years and is now nearing completion. The three editors-in-chief who are the recipients of the grant are Drs. Max Schapero and David Cline of Los Angeles and Henry W. Hofstetter of Bloomington, Indiana. The many collaborators and contributors to the dictionary include many optometrists and ophthalmologists well known to JOURNAL readers. The dictionary is the work of many men and will, when published, be of inestimable value to the profession. The funds granted by the Academy at this time are for the purpose of defraying part of the expenses in preparing the manuscript. A report on the status of this project has appeared in this JOURNAL.‡

The third grant of $125 for minor supplies and equipment was made to Dr. George C. Fitzgerrell of Los Angeles. This, too, is for an already established project. In 1950 the Academy granted Dr. Fitzgerrell $500 to build a special electroencephalographic apparatus to be used in attempting to measure the visual fields objectively. The procedure would have value for those patients in whom the plotting of visual fields was important and who were unable for one reason or another to respond to the subjective test. In addition, the electroencephalographic response to visual stimuli and certain basic problems in visual physiology will be considered. The apparatus has been completed and the present grant is to supply photographic papers, expendable

‡Max Schapero, David Cline and Henry W. Hofstetter. The Preparation and Development of a Dictionary of Visual Science. Am. J. Optom. & Arch. Am. Acad. Optom. 31.7.372-378, 1954.

electronic parts such as tubes, and other items necessary to conduct the experiment upon subjects.

The above mentioned three projects were recommended to the Executive Council by the Research Grants Committee: the initiative for the fourth arose within the Council. This grant of $300 went to Dr. Monroe J. Hirsch of Ojai, California, for a continuing study in myopia. A description of the Ojai Longitudinal Study will be found as a Special Report in the present issue of the JOURNAL. The Academy granted Dr. Hirsch $500 for a study of myopia in 1950, of which he returned $350 unused. The present grant is to be used for clerical assistance and supplies used in the study.

These projects all hold great promise for optometry. The immediate practical value of the dictionary of visual science and of the strabismus and orthoptics study is clear to all. The more distant benefits of the electroencephalographic and growth studies are also apparent. The Research Grant Committee and the Executive Council were impressed with the quality and calibre of optometric research currently in progress. The grants by the Academy, although not monetarily great, should serve well the purpose for which they were intended, namely, the encouragement of optometric research.

MONROE J. HIRSCH

BOOK REVIEW

MANUAL FOR OPTOMETRY CLINICS. V. J. Ellerbrock, O.D., Ph.D. First Edition, 175 pp., illustrated, photo-offset, paper covered, spiral binding. Published by The Ohio State University School of Optometry, Columbus, Ohio. 1954. $4.12.

This very unusual publication is intended primarily as a manual for students and staff members of the optometry clinics at The Ohio State University. It describes in remarkably complete detail every phase of the operations and functions of the clinical services in skills testing, refracting, visual analysis, lens prescription, eyewear design, dispensing, visual training, orthoptics, aniseikonia, subnormal vision, contact lenses, school surveys, and ophthalmological consultation.

Items discussed, described, and explained, with illustrations and charts, include the general organization plan, physical facilities, staff members' duties and responsibilities, clinic and office forms, fee schedules, doctor-patient relationships, clinical procedures, instructions on the care of equipment, and numerous other related items.

Several of the special sections are written by Drs. Jack Fugate,

Neal Bailey, Maurice Wareham, and Merrill Allen as collaborating authors.

This book should be of interest to optometrists wishing to review their undergraduate clinical training. It will be of special value to optometrists serving on the staffs of optometry clinics connected with hospitals, schools, or other special service agencies, and to optometrists participating in school screening surveys. Much of the advice and many of the incidental suggestions can be adapted to the needs of private optometry offices. The inclusion of a table of tolerances for ophthalmic materials, a reprint of I.E.S. recommendations on home lighting, and a reprint of recommended literature for patients add to its usefulness as a reference in daily practice.

Although dealing in large part with the very ordinary details of clinical operations, the reading is not dull. A clear style of writing, a careful subdivision of topics, and the ample use of sub-headings make it a ready reference. It lacks an alphabetized index, but the table of contents is so organized as to make it easy to locate the contained information.

H. W. HOFSTETTER

INDIANA UNIVERSITY,
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BLOOMINGTON, INDIANA.

SPECIAL REPORT

THE OJAI LONGITUDINAL STUDY OF REFRACTIVE STATE*

Monroe J. Hirsch†
Ojai, California

The average refractive state for large groups of children at various ages has been established by numerous investigators. We have recently published such data in this JOURNAL for a large group of children in the Los Angeles area. Such data, while valuable, do leave unanswered many questions concerning the growth and development of the individual eye. Our recent data suggest that it is probable that the individual child's refraction changes little between the ages of five and fourteen (the ages investigated by us), but that the average refraction for a group varies systematically toward an increase in myopia or decrease in

*Submitted on December 13, 1954, for publication in the March, 1955, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist, Ph.D., Fellow, American Academy of Optometry.

hypermetropia. We have advanced the hypothesis that from the youngest to the oldest age investigated, the majority of children exhibit less than 0.25 D. of change in refraction (a remarkably constant figure for any biological variable during this period of marked growth), but that approximately 10 to 20 per cent of the children change markedly, some going from emmetropia to 4.00 or 5.00 D. of myopia. The result of this on the average is the well-known decline of degree of hypermetropia from approximately 1.00 D. in the younger group to more nearly 0.25 to 0.50 in the older group. This hypothesis, while consistent with group data, has not been proven.

The only certain method of investigating the changes of refraction of the individual is the longitudinal study, i.e., the periodical examination of the refraction of a group of children over an extended period of time. This concept has been enunciated by many modern investigators concerned with the growth and development of the eye. Very recently, Pendse has stated the following: "The ideal method for the study of the variation of refraction according to age would be to take an adequate and unselected sample of the population of both sexes and follow the same year after year. This is known as the longitudinal study and has not still been done by anybody for obvious reasons."

The accomplishment of a longitudinal study requires a number of conditions, and it is rare that all of them may be met simultaneously. The population from which the random sample is to be drawn must be sufficiently stable so that there is reason to expect that enough of the children examined at a young age will still be available for examination at the oldest age being considered.

The investigator must be able to plan on doing the study for at least ten and preferably twelve or fifteen years, and it is best if all measurements are made by the same examiner. Pendse, in discussing our Los Angeles study (Hirsch, 1952), has pointed out that "It would have been ideal if all the observations were carried out by a single individual. This condition is also worth observing, as far as possible, in a study of this kind to reduce the 'errors of observation' to the minimum and make the data more uniform in nature." With this statement we are in complete accord. While a number of examiners may be trained so that their findings in static retinoscopy are more or less comparable, there is no doubt but that the small differences in refraction of the individual which are being sought may best be discovered if all tests are performed by the same observer.

A final condition which must be met has to do with the sponsoring institution and the general public support which the project is to

receive. If school children are to be the subjects, the cooperation of the school board, the school personnel, community agencies, and the parents themselves is essential. If the project is dependent for funds upon the support of a foundation, the continuance of funds during the duration of the study must be assured.

In considering the above mentioned conditions and the need for stability of population, investigator, and support, all independent variables, it is no wonder that a longitudinal study has still not been performed.

The Ojai study was begun six months ago. We have measured the static refraction by retinoscopy for children in the kindergartens and first grades in the grammar schools of the Ojai Valley (Nordhoff Elementary School District). This test will be repeated at six month intervals, the fall examination being done in October and November, the spring examination in April and May. These same children will be tested twice each year. Kindergarteners will be brought into the test group until we have brought 1,200 children into the study, and it is hoped that it will be possible to follow at least 500 of these through high school.

The project has the approval of the school board, the district superintendent, the school principals, and the school nurse, and without their coperation the project could never have been begun. Volunteers from the P.T.A. have helped in the clerical work and in monitoring the children during the examinations. Letters explaining the nature of the study have been sent by the school district office to all parents of children who are to be subjects, and these parents have been told that their cooperation in supplying information by questionnaire will be sought later.

In addition to the static refraction and the age of each child, the height and weight is obtained at the time of refraction and are part of the basic data. What other variables are included will depend upon the time that can be devoted to the study and the help which can be obtained. Data on the dates of contraction of contagious diseases, particularly measles, will be obtained from the health records. Certain anthropometric variables would be useful if they can be obtained. A fundus study and classification at least once in every two years would be of value, as would an ophthalmometric determination of corneal power. Any number of other variables will occur to the reader, and time and personnel will be the limiting factors. The investigator is engaged in private practice and can devote approximately a half day a week to the project throughout the year, although more time is demanded during the months that the actual testing is going on.

This report is being issued at this time to inform the profession of the existence of the project. Also, it is issued because we feel that a single study will not be enough, and it is our hope that a few other similar studies may be begun at this time so that results may be compared in fifteen years. It is realized that the happy combination necessary for such a study is rare, but a few other studies may be feasible. Since there is a good possibility that the distribution of refractive errors is not the same in different geographic areas, it would be particularly useful if similar studies could be conducted in different parts of the country. Out of all of this, we hope there will emerge ultimately a better understanding of the refractive changes in the individual and a better understanding of the nature of myopia and hypermetropia.

CURRENT COMMENTS

Terry Judith Parkins
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

OPTOMETRY LOSES THREE LEADERS

Three important leaders in optometry have died since the first of the year. These men are Dr. Clyde J. Hathaway, Pontiac, Michigan; Lord Charnwood, London, England, and Dr. Frederic A. Woll, New York City. Their passing emphasizes again that optometry has indeed become of age and that its background of scientific techniques has in the past (as it does today) attracted leaders of other disciplines to join forces with us in serving the public.

Dr. Clyde J. Hathaway, 80, had practiced optometry during his entire adult lifetime and he, with many of his early colleagues, put in place the foundations for the professional acceptance optometry now enjoys. It was the foresight, skill and determination of these early pioneers that made today's optometry possible. The passing of such a leader brings out in fine perspective the changes and progress optometry has made during their lifetimes and makes us keenly aware of the great debt we owe to these men.

Dr. Frederic A. Woll, 80, optometrist, scientist and educator made his most significant contributions to our science in the field of optometric education. During his lifespan he furthered the development of our schools and played an important part in the transition of these early schools, from the indifferently organized proprietary schools to the

splendid chartered non-profit undergraduate professional schools of today. Dr. Woll helped establish the profession's school and college accrediting agency, and himself set the early minimum standards to which all schools had to conform. This very difficult assignment—so well handled by him—assures him, for all time, a place in the hall of fame in optometry.

Lord Charnwood, 52, came to us in optometry from the engineering sciences during World War II, becoming interested in visual problems as these were related to the use of gun-sights. This was an engineering loss and an optometric gain, as he threw his tremendous energies into problems of binocular single vision and conducted many significant research projects dealing with this phenomenon. After his undergraduate work in optometry and passing his honors examination, Lord Charnwood established his private specialized optometric practice and also served on the faculty of the London Refraction Hospital. Lord Charnwood visited optometrists on this side of the Atlantic on several occasions and made many close friends here.

The death of each of these outstanding leaders in optometry is regretted and mourned through the optometric world. Each made important contributions to visual science. Each was a member of the Academy and each will long be remembered for the splendid part played in advancing the standards of optometric practice.

ACADEMY — WESTERN REGIONAL CONFERENCE

The Second Annual Western Regional Conference of the American Academy of Optometry will be held at the Founders Halls, University of Southern California, Los Angeles, April 16-17. Dr. Henry A. Knoll, dean, Los Angeles College of Optometry is the Papers Chairman.

All Pacific Coast Academy members are expected to attend this meeting which is also open to undergraduate students in optometry and to all other practicing optometrists who will be welcomed as registered guests when sponsored by a member of the Academy. Each Academy member is urged to sponsor and bring professional guests to the meeting.

Prominent people in the visual science field from the area will present papers and the Program now nearly complete should carry on the high standards set at the First Western Regional Conference at Berkeley last year.

Among the speakers will be Meredith W. Morgan, Jr., Ph.D., Elwin Marg, Ph.D., Gordon Heath, O.D., Melvin Nadell, Ph.D., Merton C. Flom, O.D., and Howard N. Walton, O.D.: their subjects covering a wide range of optometric interest.

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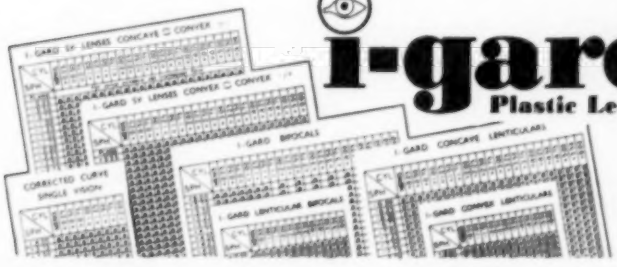

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7□ DIFF.

Eye	A	B	E BRIDGE
40	41.5	34.5	18-20-22
42	43.5	36.5	18-20-22-24
44	45.5	38.5	18-20-22-24
46	47.5	40.5	18-20-22-24

P.D.—A+E 43.5+20=63.5 P.D.

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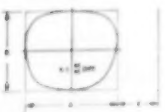
The "go-with everything" rightness of the Art-Rim Townsman is an important factor in its universal appeal. its distinctive, clean-cut, casual styling blends with all the clothes and pursuits of daily living. Rarely does a single frame offer such complete satisfaction . . . for patient . . . for you!

Colors: Briartone, Grey Slate, Gunner Brown.



EYE	A	B	E BRIDGE
42	43	36.5	20-22-24
44	45	38.5	20-22-24
46	47	40.5	20-22-24
48	49	42.5	20-22-24

P.D. — A+E 43+20 — 63 P.D.
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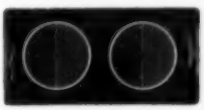

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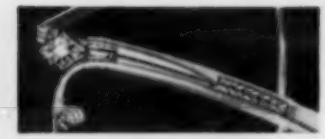

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